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How people learn to signal emotions in social contexts

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How people learn to signal emotions in social contexts

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"Simply–Never imagine yourself not to be otherwise than what it might appear to others that what you were or might have been was not otherwise than what you had been would have appeared to them to be otherwise."

- Lewis Carroll, 1866

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General introduction

Figure 1.1. The Cheshire cat in Alice's Adventures in Wonderland (Carroll, 1866)

In one of my favorite books, the famous children's story of Alice's Adventures in Wonderland, written by Lewis Carroll (1866), a girl named Alice gets lost in a forest. At one point, she runs into a creature, which introduces itself as the Cheshire cat (as displayed in Figure 1.1) and which turns out to be rather peculiar. The multi-colored furred cat is able to detach its head from the rest of the body and tends to talk in riddles. After having observed this strange animal for a few minutes, Alice asks whether the cat is mad in the head. The cat answers as follows:

> "I think it is fair to say that dogs are not mad. We all agree that when a dog growls he is angry, but when he is happy, we see him wag his tail. Yet, when a cat is happy, he will most certainly purr. A cat will sweep his tail when he is angry. So yes indeed, you might say that I am mad." (Carroll, 1866).

So the Cheshire cat makes an interesting statement: animals like cats and dogs, when they are angry or happy, typically express such emotions by a unique type of body language; if they would do it otherwise, they would be considered "mad in the head". Although this statement is made by a fictitious, curious character in

a children's story, it is consistent with how emotion researchers have looked at emotional expressions. These researchers have believed for many decades that emotions, such as happiness and anger, are expressed by specific sets of nonverbal features that are alike for people from different cultures and age groups (Tomkins, 1962). In such early accounts, it has been suggested that emotional expressions may indeed be universal as these are similarly displayed and recognized by people across the globe (e.g., Ekman & Friesen, 1975; 1978). With this in mind, it is interesting to have a closer look at the two children in Figure 1.2, these stills being taken from a study described in Chapter 3 of the current dissertation. These children were participating in an experiment that was set up so that it was likely that they would end up feeling either disappointed or happy. At first sight, the figure suggests that the children use prototypical nonverbal expressions for signaling negative or positive emotions (in these cases disappointment by frowning and pursing lips and happiness by smiling). If one would show these photographs to people with various cultural backgrounds, then these observers would probably be quite similar in how they would judge these expressions. This, in turn, could be seen as evidence for the claim that expressions of emotions are indeed universally recognized in similar ways (e.g., Ekman & Friesen, 1975; 1978). However, when looking at a larger set of children in that specific experiment of Chapter 3, we observed that the expressions of our participants were actually quite variable, and sometimes deviated considerably from the prototypical displays shown in Figure 1.2. This variability appeared to be related to the age of the children, and also depended on contextual factors, relating to how the game was played exactly.

Figure 1.2. Stills illustrating examples of child participants displaying expressions of disappointment (left) and happiness (right).

This last observation is in line with more recent approaches to nonverbal correlates of emotion, in which there is a growing awareness that the expressions people use in their natural interactions are often not prototypical. Indeed, studies that investigated spontaneous emotional expressions sometimes found that these did not always match "standard" displays of emotion (e.g., Fernández-Dols & Ruiz-Belda, 1997; Fischer, Manstead, & Zaalberg, 2003; Russell, Bachorowski, & Fernández-Dols, 2003). For example, although a number of studies succeeded in eliciting feelings of surprise with participants, these participants rarely showed the expression of surprise that is typically described in classic handbooks of facial expressions, i.e., expressions achieved through raising eyebrows, widening of the eyes and dropping of the jaw (e.g., Reisenzein, 2000; Reisenzein, Bördgen, Holtbernd, & Matz, 2006). Rather, the participants in these studies often only showed a subset of these features. A possible reason for this discrepancy between the display and feeling of surprise may be that people modulate their emotional expressions, as a function of various contextual factors. More general, the possibly somewhat simplified view claiming that emotions are expressed by unique sets of features has been questioned to varying extents by several other approaches on emotions (e.g., Fernández-Dols & Crivelli, 2013; Prinz, 2004; Russell & Feldman Barret, 1999; Scherer, 2009; Scherer & Elgring, 2007, Scherer, Schorr & Johnstone, 2001). Instead, emotional expressions are nowadays often considered to depend on situational characteristics of an emotion-eliciting event (e.g., Fernández-Dols & Crivelli, 2013; Scherer, 2009). For example, people may use less, more or even different nonverbal features for showing a particular emotion when they are in the company of someone else, perhaps because they want to be polite, or in order to avoid any other socially uncomfortable situations (Matsumoto, Hee Yoo, Hirayama & Petrova, 2005).

While the role of such contextual factors, like the presence of another person, on nonverbal expressions of emotion seems intuitively clear, it has so far not received much scholarly attention in empirical research. Moreover, the number of studies that did look at these factors tends to be limited to analyses of adults. To our knowledge, no empirical studies have looked into the way context affects children's emotional expressions, except for a few studies that considered how children who are alone express emotions differently from children who are co-present with other children (e.g., Reisenzein et al., 2006; Shahid, Krahmer & Swerts, 2008; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006). It is unfortunate that there is a lack of studies that compare these expressions in different age groups, as one would expect that contextualized use of nonverbal features changes as a function of age. When they grow older, children's social awareness

increases, and as a result, they may be expected to become better in assessing what type of nonverbal behavior is appropriate or effective in specific social contexts (Ekman & Oster, 1979; Gnepp & Hess, 1986; Saarni, 1979). For instance, when receiving a present they do not like, young children may openly express their disappointment (like the 8-year-old boy in Figure 1.2 does, who, after having played a game, has just heard that he has been given a consolation prize, instead of the first prize). However, older children, who are more knowledgeable about the social rules that hold in this specific circumstance, may have learned that they should adjust their nonverbal behavior and show some appreciation, even when the prize is not exactly the one they had hoped for (Kieras, Tobin, Graziano & Rothbart, 2005). They would be more likely to smile and look thankful, no matter which prize they get assigned to, simply because such behavior is in line with general rules of politeness. In other words, when looking at the impact of social context on nonverbal behavior, it makes sense to compare people in different age groups, as younger and older children are expected to differ in how they adapt their expressions to the specific situation they are in.

Therefore, this dissertation is concerned with a developmental approach to the nonverbal expression of emotion, and specifically studies how contextual factors have an impact on these expressions. To this end, we conduct a number of experimental studies with participants of different age groups, from primary school children to older adults, that are put in different social contexts (e.g., competition versus collaboration, alone versus in the presence of a peer). The following sections introduce relevant theories and earlier research on this topic and describe the general approach of the various studies of this dissertation.

Nonverbal Expressions of Emotions

Nonverbal behavior can be characterized as a way of communicating by means other than words (Knapp & Hall, 2010). So, while nonverbal features have often been studied as expressions of emotions, they may in fact signal a wider range of functionally relevant information that can have a significant impact on how people communicate. Let us illustrate this with an example: imagine a father who has just informed his daughter that he wants to give her a birthday present, namely a Golden Retriever puppy. Let's say that instead of being happy with this gift, the girl is rather disappointed, as she was hoping to get a pony. Obviously, her emotions regarding this specific event may become visible from her nonverbal expressions, but these may also interact with cues to other kinds of information.

First, nonverbal features have been shown to function as markers of important information in an utterance. For instance, a speaker may highlight specific contrasts in a message by prosodic (the girl may tell her father: "no, I do not want a *dog*, I want a *pony*"), as well as visual cues (imagine this girl raising her eyebrows with the words *dog* and *pony,* for underlining her expectations and disappointment, see Krahmer and Swerts (2004) and Ekman (1979) for more research on the functionality of eye brow movements). Second, nonverbal behavior can also be used to regulate a conversation between people (Knapp & Hall, 2010). We can use nonverbal cues, like gestures, to emphasize the start or end of a sentence (the father saying, "you are not getting a pony, I just bought you a dog", making a "stop" movement with his hand to let his daughter know his saying is the end of the discussion; Bavelas, Chovil, Lawrie & Wade, 1992). And finally, most relevant for the subject of the current dissertation, nonverbal behavior can represent a speaker's emotional state (Knapp & Hall, 2010). While communicating with others, facial expressions can give information on how the speaker is feeling, partly irrespective of the words he or she is using. Imagine the girl in our example would react to her father's birthday present by saying the following: "I thought you were getting me something else". Using different nonverbal, facial expressions, as exemplified in Figure 1.3, the girl may alter the father's perception of this message. When she would smile while speaking, as the girl in the leftmost picture in Figure 1.3 does, he may perceive his daughter to be happy with his present. She may have expected something less desirable than a dog, like toys, or a doll. However, if the girl would put on a scowling face, like the girl in the rightmost still in Figure 1.3 does, the father would probably realize his daughter would rather redeem the Golden Retriever puppy for a pony. This last function of nonverbal behavior, representing someone's emotional state is most important for the research reported in this dissertation.

Figure 1.3 An example of how the nonverbal expressions of a young girl can give meaning to the verbal message "I thought you were getting me something else". Pictures taken from the Radboud Faces Database (Langner et al. 2010).

A review of various emotion theories reveals that there is quite some disagreement about what the term "emotion" precisely refers to. In this dissertation, we decided to use the definition of emotions as formulated by Levenson, Soto and Pole (2007), even when we are well aware that this is just one of the possible definitions:

> "Emotions are short-lived psychological-physiological phenomena that represent efficient modes of adaptation to changing environmental demands."

This definition suits our purposes as it highlights a number of factors that we consider being important for the studies we describe in this dissertation. Let us illustrate some key elements of this definition by once more considering the example of the girl who did not get a pony as a birthday present. First, according to Levenson et al. (2007), emotions represent *efficient modes of adaption to changing environmental demands.* Thus, we need to experience an event (e.g., receiving a dog), for eliciting a particular emotion (e.g., disappointment) that is linked to earlier subjective experiences (e.g., the girl may have dreamed about her own pony for years); see also Scherer (2009). Second, Levenson et al. (2007) argue that emotions are *short-lived experiences*. Unlike moods, defined as mental states that last for a relatively longer duration, emotions are intense, short experiences (Siemer, 2009). In the case of the girl, her disappointment about her birthday present is considered to be an emotion, on the assumption that it lasts a

relatively short period. Last, emotions are supposed to be *psychological-physiological phenomena (*Levenson et al., 2007). Emotions have both affective and embodied elements (Damasio, 1999; Prinz, 2004). An emotional experience has to evoke a particular action and is therefore typically accompanied by expressive behavior and bodily responses (Darwin, 1872; James, 1884; Lange, 1885). For example, the young girl may start crying when she is sad, because she did not get the birthday present she wanted. In view of the current dissertation, the definition by Levenson et al. (2007) implies that this bodily response is something we are, to some extent, able to regulate, either intentionally or not, depending on individual traits and contextual factors (i.e., *changing environmental demands*).

The definition of Levenson et al. (2007) deviates from how emotions have been treated in earlier work especially in as far as these were concerned with discrete, basic emotions and their universal character (e.g., Darwin, 1998; Ekman, 1992; Izard, 1971; Tomkins, 1962). These earlier theories have focused on how people express their emotions through affect programs (Ekman, 1992). These programs are directly linked to the motivational cognitive system and provide people with the ability to experience prototypical emotions, or a combination of those, which may be accompanied by specific facial expressions (Tomkins, 1962). Discrete emotion theories consider facial expressions of emotions to be universal and similar for all individuals. Although there is some disagreement among researchers about which emotions they consider to be basic, there is a relative consensus about the six emotions displayed in Figure 1.4: happiness, anger, fear, disgust, sadness and surprise (Lewis, Haviland-Jones & Feldman Barrett, 2010).

Figure 1.4. Prototypical displays of the six basic emotions, from upper left to bottom right: anger, fear, disgust, surprise, happiness and sadness (Langner et al. 2010).

According to this approach, emotional expressions are a result of years of modification for humans' specific needs to survive (Darwin, 1872). For example, the emotion of fear, as displayed in the top middle in Figure 1.4, is accompanied by a highly aroused feeling, widening of the eyes and opening the mouth, all of which can facilitate flight or the escape of danger (Schützwohl & Reisenzein, 2012). Widening the eyes can improve our sight, opening the mouth facilitates taking a deep breath which, together with a highly aroused feeling, gives one more energy to run away.

However, this evolutionary view on emotions has been questioned by several other (dimensional) approaches on emotions. For example, Russell and Feldman Barrett (1999) refer to named emotions (like happiness or anger) as prototypical episodes of core affects (affective feelings), which are not necessarily "basic", or similar to all individuals. According to their theory, emotions are supposed to vary on a continuum of two orthogonal factors, arousal (from passiveness to

activeness) and valence (from negative to positive). For example, happiness would be a substantially positive, somewhat active emotion, whereas anger would be considered as a fairly active and very negative emotion.

Recently, research has been focusing more on subjective aspects of emotions, and various studies have shown that an individual's evaluation of a situation may have an impact on emotional expressions (e.g. Fernández-Dols & Crivelli, 2013; Mumenthaler & Sander, 2012; Scherer, 2009; Scherer & Ellgring, 2007). According to the componential model of emotions (e.g. Scherer, 2001; 2009; Scherer & Ellgring, 2007), emotions are defined as on-going processes in which we are continuously estimating and evaluating the significance of situations for our well-being. Various characteristics of the situation may be important for emotion elicitation: the novelty, pleasantness and relevance of the event, for example, co-determine the valence and intensity of an emotional response. These characteristics have been called *appraisals* (e.g., Scherer, 2009), and it has been argued that individual, subjective appraisals determine the construction of emotional expressions (e.g., Frijda, 1986; Mumenthaler & Sander, 2012; Scherer, 2009; Scherer et al., 2001). Emotions are constructed as cognitive appraisals nested in behavioral scripts. These scripts instruct us what to do when something of concern happens. The way we react to a certain event by expressing an emotion depends not only on the variety of appraisals this situation elicits (like a social context), but also on behavioral scripts that are available. As a result, different people may express the same emotion differently (Mumenthaler & Sander, 2012).

This dissertation will contribute to current research on emotions by examining nonverbal features of expressing emotions, and by asking whether and how these expressions are affected by different appraisals, especially related to social contextual factors.

Social context

According to appraisal theory, our emotions are constructed by our assessment of an event that is significant to us. The process that determines how context can have an impact on emotional expressions can be modeled in terms of push and pull effects (Banse & Scherer, 1996). Push effects of emotions represent how our internal state influences the display of emotions. For instance, we may dislike a specific present, and would feel inclined to show this disappointment through our facial expressions. However, pull effects prohibit people to freely show their

internal emotions, because that could be inappropriate in specific social contexts. In this way, emotional expressions are jointly determined by both internal (push) and external (pull) factors. Evidence for this kind of push and pull model can be gleaned by observing how people use and interpret emotions in specific interactive contexts, especially when considering emotions that are not typically treated in discrete emotion theories. For instance, consider the case of uncertainty, which is usually considered to be an emotion that has a clear social function as it involves information exchange as well as self-presentation of the speaker (Smith & Clark, 1993; Swerts & Krahmer, 2005). For the purpose of self-presentation, people tend to have specific strategies to save face (Gnepp & Hess, 1986). In particular, when a person answers a question while not feeling particularly confident about the correctness of the answer, the person can show this uncertainty using specific nonverbal cues. If the answer would turn out to be incorrect later on, the speaker at least has not pretended to be very confident, in this way making it clear that his/her response should be taken with a grain of salt (Swerts & Krahmer, 2005).

The way social contexts may affect emotional expressions has often been framed in terms of so-called display rules. These are (sometimes implicit) conventions that help individuals manage and modify their emotional expressions, depending on social circumstances. According to the literature, these display rules mainly have two functions (Ekman & Friesen, 1975). First, they can serve a cultural, pro-social purpose (for example, shaking hands is appropriate is some countries, in others it is not). Second, display rules can function as self-protective, like in the case of saving face when showing uncertainty towards an addressee when answering a question. Self-protective display rules are based on an individual's expectations of the consequences of expressing certain feelings in particular social contexts (Ekman & Friesen, 1975; Gnepp & Hess, 1986; Saarni, 1981). There are multiple ways in which display rules can operate in order to manage expressions, by exaggerating or minimizing expressions of emotions, but also by neutralizing, masking or simulating them (Matsumoto et al., 2005; Saarni, Campos, Camras & Witherington, 2006). In this way, people can regulate their social interaction and thereby steer the kind of impression they may give an addressee (DePaulo, 1992; Ekman & Oster, 1979; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006).

This dissertation seeks to find further evidence for how social context affects the way we express emotions. Different social contexts require different uses of display rules. By varying the social context in which the emotion elicitation takes

place, we examine in which way people regulate their emotional nonverbal behavior.

Development

Display rules are constructs we learn gradually as we get older (Ekman & Oster, 1979; Gnepp & Hess, 1986; Saarni, 1979; Saarni et al., 2006). Various studies have shown that the relative importance of nonverbal features for communicative purposes changes as a function of age. Infants' verbal capabilities are still limited, and therefore they make extensive use of nonverbal cues to communicate. For example, when a 6-months-old baby is hungry, his or her attempt to inform someone about this will probably involve nonverbal behavior like crying. As children grow older and their verbal skills improve, they tend to use fewer nonverbal cues for the exchange of this kind of information and get better in using nonverbal features for other social purposes (Knapp and Hall, 2010). Regarding typical emotional behavior, infants of only a few months old appear to express similar emotional displays we see in adults, for example to express joy (Oster, Hegley & Nagel, 1992), surprise (Scherer, Zentner & Stern, 2004) and pain (Prkachin & Craig, 1995). With age, children become more self-conscious and consequently, increasingly experience more complex emotions, like shame, guilt and embarrassment. These social emotions also become more apparent when children learn to act according to certain social rules, and become more socially aware of others.

It has been attested in a number of studies that children's social awareness and knowledge of display rules increases with age, as they become better in assessing what type of nonverbal behavior is appropriate or effective in specific social contexts (Ekman & Oster, 1979; Garret-Peters & Fox, 2007; Gnepp & Hess, 1986; Saarni, 1979). Saarni (1981), for example, showed that children's knowledge of display rules substantially increases between the age of 8 and 11. Apparently, 8-year-old children apply display rules in about 25 per cent of social situations that require the use of these social conventions, while 11-year-old children seem to use display rules in 50 per cent of the relevant social situations. Moreover, research indicates a developmental shift across the elementary-school years in which older children, compared to younger children, experience greater socialization pressure to regulate emotional expressions (Shipman, Zeman, Nesin & Fitzgerald, 2003). Most probably, children's use of nonverbal cues in order to meet personal goals and expectations of their surroundings develops as a

function of their increasing knowledge of display rules (Garret-Peters & Fox, 2007; Gnepp & Hess, 1986; Saarni, 1984).

This dissertation focuses on developmental aspects of the social construction of emotional expressions. While most studies in this domain are based on analyses of younger and older children, not much is known about whether the use and function of nonverbal behavior continues to develop in adults as well. Interestingly, however, there are several reasons to assume that the way older adults express social emotions may differ from the way younger adults do this. For instance, older adults are arguably less expressive than younger adults or children (Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Gross et al., 1997; Levenson, Carstensen, Friesen & Ekman, 1991). Although findings on expressions of positive emotions are mixed, negative emotions like fear and anger appear to be less intense in older adults, compared to young adults (Carstensen et al., 2000; Gross et al., 1997; Levenson et al., 1991), possibly due to a better-developed emotion regulation mechanism (Charles & Carstensen, 2007; Gross et al., 1997; Levenson et al., 1991). Therefore, this dissertation takes different age groups into account, children, young adults and older adults and presents a developmental approach to the way nonverbal expressions are affected by contextual information.

Methodology

To study possible effects of social context on emotional expressions of children, and younger and older adults, we developed a research design that allowed us to elicit spontaneous nonverbal expressions in a dynamic and natural but controlled way and that is suitable for the analysis of all age groups.

Reviewing earlier research on emotional expressions, there are two commonly used methods for eliciting and analyzing nonverbal behavior: experimental studies in laboratories, and observational field studies (Fernández-Dols, 2013). Laboratory studies typically aim to get a "clean" view on emotional expressions. They facilitate certain causal claims because groups of participants can be subjected to identical situational procedures (Hubbard, 2001). Facial behavior can be recorded in a uniform and unobtrusive manner and self-reports can provide useful insights in participants' feelings. However, emotions elicited in laboratory studies may differ in a number of respects from real-life emotions (Schützwohl & Reisenzein, 2012). For example, eliciting surprise by showing a video clip, in which a surprising event takes place, like the explosion of a bomb, is

probably less intense than when this event would happen in real-life. Moreover, asking people to report their emotional feelings is bound to make them conscious of the purpose of the study, which in turn, might affect their expressions ("Can you please tell us to which degree you are surprised" would interfere with the unexpected character of surprise, yielding expressions that are different from how a person would show such an emotion in natural settings). On the other hand, observational field studies aim to capture spontaneous expressions of participants in their natural environment, preferably without much intervention of experimenters. Although this method provides a useful way of examining frequencies and intensities of emotions, the variety in situational factors and the lack of uniformity in recordings make it difficult to make statements about, for example, causalities (Fernández-Dols, 2013; Hubbard, 2001). Moreover, naturally occurring situations may invoke social norms that could influence emotional expressions (Matsumoto et al., 2005).

As a compromise, the general methodology used in this dissertation combines advantages of both approaches as described above. In all studies, we aim to elicit spontaneous emotional expressions in a controlled setting that is applicable to all age groups. Self-reports are taken into account to a certain extent, in such a way that these do not interfere with the elicitation of the emotions. Contrary to most laboratorial studies on emotional expressions, we aim for a controlled setting which is as natural as possible, using a game-based approach. An emphasis on the importance of winning or losing a game is likely to increase emotional arousal of participants (Hubbard, 2001). Moreover, game-based experiments are appropriate for child participants as well, as children are familiar with playing structured games. We use production experiments in which participants are invited to play quiz-like games alone or in pairs, and outcomes and contextual factors are relatively easy to manipulate. Next, depending on each study's objective, we analyze video recordings of the elicited emotional expressions either by perception experiments and/or by feature labeling.

First, in all studies, we use perception experiments for analyzing data. In these experiments, we ask a substantial amount of judges to rate a series of video recordings on the presence or intensity of a certain emotion. In this way, we are able to analyze the perception of the emotions produced by participants in different experimental conditions (Kromm, Farber & Holodynski, 2014). This dissertation tests whether contextual factors are important for emotional expressions. This implies that we express our emotions with the purpose that someone else will perceive them (as explained by pull effects, see Banse & Scherer, 1998). By using perception studies, this dissertation focuses largely on

how emotional expressions are "interpreted" by others, and whether the impression of emotions varies as a function of the contextual factors in which they were elicited.

In addition, we label features that participants use for expressing emotions. By doing so, we are able to get an overview of the non-verbal cues that are used for the expression of certain emotions and explain any effects we find in perception studies. We use both manual and automatic methods for labeling our data. Explicit labeling protocols based on the Facial Action Coding System are used for all studies (FACS, Ekman & Rosenberg, 1997). In this system, facial expressions are described by means of Action Units (AUs), i.e., muscular actions: for example, *smiling* is related to AU 12, 13 and/or 14, and *eyebrow movement* is related to AU 1 and/or 2. More explicit details on FACS can be found in the following Chapters.

In the studies that focus on child data, we mainly concentrate on nonverbal features that are considered to be the strongest correlates of certain emotions. Since we want a more specified overview of used expressions with the older adults, as this is one of the first studies that look into this age group's nonverbal behavior in a social context, we use automatic coding to analyze the presence of all Action Units used by participants in this particular study. For this purpose, we use a software tool for frame-based automatic facial expression recognition, CERT (Computer Expression Recognition Toolbox; Littlewort et al., 2011). Based on a machine-learning algorithm, the tool identifies the face region in a video and detects 44 Facial Action Units with a reasonably high accuracy, comparable to the accuracy obtainable with human annotators (Ekman & Rosenberg, 1997).

To summarize, this dissertation comprises research that uses experimental paradigms for eliciting spontaneous emotional expressions in a controlled manner, applicable to various age groups. We analyze emotional utterances thoroughly by focusing on both the production as well as the perception of emotional cues.

Overview

This dissertation consists of four studies, which are presented in Chapters 2 to 5. All Chapters are based on separate manuscripts, that have either already been published (Chapters 2 and 4) or have been submitted for publication (Chapters 3 and 5) in international peer-reviewed journals. As they cover self-contained studies, each Chapter has its own abstract, introduction, discussion, reference list and appendices. This may result in some overlap regarding definitions or

introductions of specific theories throughout this dissertation. In addition, due to the requirements of different journals involved, there may be differences in the presentation and analyses of results.

The overall aim of this dissertation is to examine how emotional expressions are affected by our social environment and whether this develops as we grow older and get more aware of the social context. The study described in **Chapter 2** investigates to what extent the expression of the basic emotion of surprise is affected by situational factors. Research on surprise expressions has shown that participants who reported feelings of surprise rarely produced prototypical expressions of surprise (e.g., Reisenzein et al., 2006). Possibly, environmental factors influence the way people express their emotions as they may adapt their behavior to situational factors, for instance when people find themselves in contexts in which such expressions are deemed to be unsuitable. Instead of trying to study this particular emotion out of context to get a clean view of a basic surprise expression, the study described in Chapter 2 systematically varies some contextual appraisals for the elicitation of surprise. More specifically, we vary the cause and the social context of the emotion when eliciting surprise reactions. We examine expressive behavior of both children and adults, given our expectation that people gradually learn to regulate their behavior (Gnepp & Hess, 1986; Saarni, 1984; Saarni et al., 2006). In this way, this study examines whether the impact of the factors under study changes together with the development of social skills. We analyze surprise utterances by labeling surprise- and valence-related cues and by asking third party judges in subsequent perception studies to rate surprise levels. As such, this research answers the question to what extent contextual factors should be taken into account when investigating "basic emotions" like surprise.

Next, **Chapter 3** zooms in further on how social factors may affect emotional expressions of children. Building further on Chapter 2, in which we explore whether different social rules may evoke different emotional expression, the study described in this Chapter shows how a more interactive context, in which participants are urged to pay attention to other people's emotional reactions, influences emotional expressions. This Chapter does not focus on one particular emotion, but rather investigates, more generally, if different appraisals influence children's expressions. In particular, this study examines whether children's expressive behavior while receiving a disappointing gift or a satisfying gift is affected by the presence of a peer who receives a 'better' or 'worse' gift. Since we expect that social appraisals may vary as a function of time, we consider it likely that in the course of receiving a gift, conflicting appraisals alternate, which may

influence children's emotional expressions. Therefore, a second aim of this Chapter is to investigate how emotional expressions may change in the course of a child's response, where we are specifically interested in the extent to which changes in their assessment of the social contact has an impact on their expressive behavior. We analyze this by letting independent judges rate children's levels of happiness in various reaction episodes. Altogether, the research in this Chapter gives insight into how social appraisals influence emotional expressions of children.

The study presented in **Chapter 4** explores whether children's emotional expressions of uncertainty are affected by various situational factors. Whereas Chapter 2 and 3 mainly focus on expressions of surprise and happiness, which are both basic emotions, this study is concerned with an emotion that is more socially constructed, to wit: uncertainty. Uncertainty is an emotion most people experience in daily life, and often, signaling lack of confidence serves a social function (Swerts & Krahmer, 2005). For example, when someone asks us a question, and we are unable to retrieve the answer right away, we cue these uncertain feelings to the questioner so that he or she can lower expectations about the correctness of our answer. To elicit utterances that vary in levels of certainty, the study described in Chapter 4 relies on a so-called Feeling-of-Knowing experiment (e.g., Hart, 1965) in either a collaborative context or a competitive context. In this way, we investigate the significance of a change in contextual factors for (un)certainty expressions. We analyze the resulting expressions by labeling cues and by asking third-party judges to rate speakers' utterances on the perceived level of certainty. In this way, this Chapter answers the question to what extent social emotions like uncertainty are shaped by contextual factors.

Next, **Chapter 5** provides insight into emotional expressive behavior of older adults. There are several reasons to assume that the way older adults express social emotions like uncertainty may differ from the way younger adults do this. First, older adults are less accurate in estimating the correctness of their answer (Souchay, Isingrini, & Espagnet, 2000; Souchay, Moulin, Clarys, Taconnat & Isingrini, 2007). Second, older adults tend to be less expressive for negative emotions like uncertainty (Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Gross et al., 1997; Levenson et al., 1991). Third, due to memory problems, older adults experience more retrieval failures than younger people. Therefore, they may feel more frustration while being uncertain about their answer (Gollan & Brown, 2006, Burke, MacKay, Worthley & Wade, 1991). Therefore, in the final study of this dissertation, uncertainty expressions of older adults are

investigated. We conduct a Feeling-of-Knowing experiment with twenty-four older adults (with an age ranging from 70 to 95) and analyze their certainty utterances by labeling their utterances both manually and automatically and by conducting a subsequent perception test, in which judges rate participants' certainty levels.

Finally, **Chapter 6** contains the general discussion and conclusion.

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2

Contextual effects on surprise expressions: A developmental study

Abstract

Although research succeeds in eliciting spontaneous feelings of surprise with participants, these participants rarely show a prototypical expression of raising eyebrows, opening mouth, and widening eyes. In other words, there seems to be a discrepancy between the display and feeling of surprise. To get a better understanding of this discrepancy, we assessed what factors influence the display of surprise in children (study 1) and adults (study 2). In both studies, we conducted a quiz-like experiment, in which we manipulated the social context (participants either competed or collaborated), and various quiz questions to extract reactions of surprise (either caused by unexpectedly correct or unexpectedly incorrect answers). Results show that cause and social context did not affect the appearance of specific features in participants' surprise display. However, we did find these factors to interact with regards to the intensity of perceived surprise displays of adults. For children, these relations were less complex. Overall, we can conclude that the expression of surprise is indeed moderated by contextual factors, namely cause of the surprise, social context, and age.

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Visser, M., Kramer, E. J., & Swerts, M. (2014). The nonverbal expression of surprise: effects of cause, social context and age. *Journal of Nonverbal Behavior,* 1-25.

Introduction

People can show their surprise in a variety of contexts. Imagine you and your friends are participating in a pub quiz, where you form a team with a few people playing against other teams. The quiz consists of a number of questions asked by the quiz leader that have to be answered in a number of rounds. At one point, you are sure one of your teammates gives an incorrect answer to a relatively easy question, e.g., responding with "Munich" in response to the question "What is the capital of Austria?" You are struck by surprise; how can he not know the correct answer? In a follow-up round, you again hear a similarly obtuse answer, again to a question that you found fairly easy to answer, but this time produced by a team member of your opponents. Once more, feelings of surprise emerge and you wonder why your opponent does not know the correct answer to such an utterly simple trivia question. While the two examples above constitute cases in which people are surprised by a similar event (an incorrect answer to easy question), the situation is quite different, given that the response came from either a team member or an opponent. The general question we want to address in this article is whether such contextual factors, as well as others, have an impact on how people express their surprise.

Surprise is generally defined as an emotional state experienced as a reaction to an unexpected interruption in an on-going action (Silvia, 2009). The examples above are fully in line with this definition. Still, it is intuitively plausible that people would express their surprise differently in these situations, since the social context of the elicited emotion is different. In the first example, the context contains a *teammate* who gives an incorrect answer, in the second example by an *opponent* who gives an incorrect answer. The social context of playing a game, like when we are collaborating or competing, might trigger different kinds of nonverbal behavior, depending on whether particular actions (e.g., giving an incorrect answer) are seen as increasing or decreasing the chances of goal attainment (e.g., winning the game) (Deutsch, 1949; Johnson & Johnson, 1974; Kelley & Thibaut, 1969; Roseth, Johnson, & Johnson, 2008). For example, people can allow themselves to be open in one context, like when they are surprised by an incorrect answer of their opponent, or they may want to keep a poker face for strategic reasons, like when they are surprised by an incorrect answer of their teammates.

Moreover, the expression of surprise could be affected by other factors as well. For example, during a typical pub quiz night, you might also find yourself

in a situation in which you are surprised by an unexpectedly *correct* answer, instead of an *incorrect* answer. Your teammate or your opponent, completely against your expectations, appears to know the answer to a question you never had imagined this person could have answered. In that case, again, your surprised reaction may differ from an emotional reaction caused by an unexpectedly incorrect answer. The assumption that a person's emotional expressions, including surprise, could be affected by such contextual factors is in line with the basics of appraisal theory (e.g., Scherer, Schorr, & Johnstone, 2001). This theory states that emotions are influenced by people's evaluation of their circumstances. More specifically, a certain context can make us interpret feelings and express emotions differently.

Even though there is a growing awareness that contextual factors have an effect on emotional expressions (e.g., Fernández-Dols & Crivelli, 2013), there is little research that has focused on how such factors may impact surprise. So far, studies in this area have mostly been focusing on describing and finding prototypical displays of surprise. Traditionally, surprise has been claimed to be signalled by the raising of eyebrows, opening of the mouth, and widening of the eyes, as displayed in Figure 2.1. For instance, the seminal work of Ekman and Friesen (1975, 1978) shows that the combination of these features is universally recognized as the expression of surprise. However, when researchers try to actually elicit the emotion of surprise with participants, this prototypical display is rarely shown (e.g., Reisenzein, Bördgen, Holtbernd, & Matz, 2006). It that respect, there appears to be a low emotion-facial display ratio, which means that when participants indicate that they feel surprised, they do not frequently use this complete set of features to express their emotion. In the research to be reported in the current paper, we investigate several factors that might influence the display of surprise, and could determine the extent to which people produce the prototypical correlates of surprise. In particular, we focus on the cause of surprise and social context. Since we believe expressions of surprise are affected by a person's social environment, we expect different expressions for children and adults. Imagine the participants in our pub quiz example were merely children. Children are less capable of regulating their behavior and expressions than adults, as this is something that people learn gradually (Gnepp & Hess, 1986; Saarni, 1984). Therefore, this study takes several age groups into account, when looking at expressions of surprise.

Figure 2.1. The prototypical display of surprise, taken from the Radboud Faces Database: raising eyebrows, widening eyes and dropping jaw (Langner et al., 2010).

Background

Surprise is often argued to be one of the six basic emotions, together with happiness, anger, fear, disgust, and sadness (Lewis, Haviland-Jones & Feldman Barrett, 2010). Considering a dimensional view on emotions, these emotions

can vary in arousal (varying between no arousal and high arousal) and valence (from negative to positive). Surprise is often described as a high-aroused emotion that is also negative (Ortony, Clore, & Collins, 1990). According to consistency theories, in particular, surprising events often have negative associations. This is based on the assumption that people need to confirm expectations to anticipate and prepare for future events, and when reality appears to be different than expected, people experience this incongruence as negative (Cooper, 2007). However, we argue that the valence of a surprise event could depend on its context. For example, if you open your living room curtains in the middle of the night and you see a man standing outside, odds are you will be surprised. Yet, the origins of your surprised emotion will vary depending on whether you see a man wearing a balaclava or your cousin who has lived in another country and you have not seen for years. Still, both situations are in concordance with the description of surprise, e.g., the one given by Silvia (2009). Apparently, initial feelings of surprise may result in differently orientated expressions, related to the origin of the emotion's cause (e.g., Shepperd & McNulty, 2002). Therefore, it is presumable that when someone is surprised by a positive event, like giving an unexpectedly correct answer to a difficult question, he or she will experience this as a pleasant surprise and the accompanying facial expression would differ from the facial expression of someone who is unpleasantly surprised by a negative event, like giving an unexpectedly incorrect answer to an easy question. Therefore, in our research, we ask whether surprise is expressed differently as a function of the cause of the emotion.

Previous research has rarely studied surprise caused by different events, with the exception of a number of studies that compared surprised expressions caused by neutral, pleasant, and unpleasant events (e.g., Reisenzein et al., 2006, Scherer, Zentner, & Stern, 2004). No significant difference in expressions of surprise caused by different events was found. This could be explained by the non-social context in which the emotions were elicited, as Reisenzein and colleagues aimed for a "clean" view on the expression of surprise (Reisenzein et al., 2006). To our knowledge, the only social aspect that has been studied in this area is the presence of friends and strangers while eliciting a surprised emotion (Reisenzein, Studtmann, & Horstmann, 2013; Schützwol & Reisenzein, 2012). However, these previous studies focused on the contrast between social versus non-social settings, while as we have argued above, the *type* of social context may matter as well.

We think that the type of social context may indeed be an important indicator for the expression of surprise, since people tend to exaggerate, minimize, neutralize, and fake expressions, depending on the social context they are in (Ekman & Friesen, 1975; Ekman, 1997). The social rules that are used by people for deciding how they should express themselves emotionally have previously been termed "display rules" (Matsumoto, Hee Yoo, Hiramaya, & Petrova, 2005). Display rules can serve both pro-social and self-protective purposes and are based on an individual's expectation of the consequences of expressing a particular feeling in a given context (Ekman & Friesen, 1975; Gnepp & Hess, 1986; Saarni, 1981). By adjusting emotional expressions one can regulate the social interaction and thereby affect the relationship (DePaulo, 1992; Ekman & Oster, 1979; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006;). The way in which surprise is expressed, and the extent to which someone does this in particular contexts might affect someone's social position. For example, showing surprise when someone gives an incorrect answer to a question during a knowledge quiz, might lead this person to think that others will view him or her as being unintelligent. However, placing this in a more complex social context, for instance, when you are cooperating or competing with this person in this quiz, might affect these consequences. Different display rules may be used in such a way that auditory and visual cues may differ as well. For example, when playing a quiz game in a collaborative context, players have a joint goal, which could lead participants to become more open about their internal states. Therefore, they may be intuitively more willing to show emotions like surprise. By contrast, in a competitive context, players may be more strategic in how they display their internal state, so that their surprise might be suppressed or minimized. In short, the social context is a potentially important factor when expressing an emotion like surprise. However, previous studies on the expression of surprise do not take different social contexts with accompanying display rules into account (e.g. Camras et al., 2002; Reisenzein et al., 2006; Scherer et al., 2004;). We believe it would be interesting to study the effects of different social contexts on emotional expressions. Since game-like contexts like competition and collaboration have differentiated display rules and would fit well in the perspective of our experiments, we chose to look into the effect of a collaborative context and a competitive context on the expression of surprise.

In this research we will focus on factors that influence the expression of surprise with both adults and children. Adjusting behavior and expressions to a social context is something people learn gradually (Gnepp & Hess, 1986;

Saarni, 1984). According to the Developmental Interactionist theory by Buck (1994), emotions are constructs that originally consist of spontaneous elements, but also have symbolic and moral functions. As people grow older, their emotions appear less spontaneously and get a more symbolic and moral function with a focus on their social environment. Arguably, children need time to acquire the social display rules, which means that children are not as skilled in that respect, compared to adults (Swerts, 2011). Indeed, in line with what we know about their general cognitive development (Piaget, 1950), there are reasons to assume that children's use of nonverbal behavior changes as they grow older, along with the relative importance of nonverbal features for communicative purposes. Given that their verbal skills are still limited, infants make extensive use of nonverbal cues to communicate. For example, when a 6-month-old baby feels uncomfortable in some way, his or her attempt to inform someone about this will involve nonverbal behavior such as crying. As children grow older and their verbal skills improve, they tend to use less nonverbal cues for the exchange of this kind of information and get better in using nonverbal features for other social purposes (Knapp & Hall, 2010). Children's knowledge of display rules and social awareness increases as they grow older and in this way, children learn which behavior is considered to be appropriate or effective in specific social contexts (Ekman & Oster, 1979; Gnepp & Hess, 1986; Saarni, 1979).

Research on children's expressions of surprise has been limited. Earlier studies in this field involved mainly perception and understanding of emotions based on "theory of mind" models (e.g., Hadwin & Perner, 1991) and rarely concerned children's expression of surprise. Research that did study children's expression of surprise was limited to the study of young children (e.g., Scherer et al., 2004). However, it is important to study the expressions of surprise with older, more socially skilled, age groups as well, since Saarni (1979) showed that children's adjusting behavior to social contexts doubles between the ages of 8 and 11. Therefore, we included both age groups (8 and 11 years old) in our studies, and compared their behavior with those of adult participants.

Present Studies

The current research aims to study how the cause of surprise, social context, and age may affect nonverbal expressions of surprise. To this end, we designed a game-based experiment in which participants of different age groups play a

knowledge quiz in either a collaborative context or a competitive context. By manipulating various questions in the knowledge quiz, we create situations in which the speaking participant's answer is unexpectedly correct, or unexpectedly incorrect, according to the knowledge of the listening participant. This paper contains two studies. First we describe a study with 8-and 11-year old children that consists of both a production experiment and a perception experiment. In the production experiment, we focus on the appearance of surprise features (rising of eyebrows, widening of eyes, and dropping jaw) and valence related features (smiling as a positive feature, frowning as a negative feature). We analyze these features using a coding task. In the perception experiment, we ask independent judges to rate the participants' level of surprise. The second study contains similar experiments, but with adult participants. In this way, we are able to test our assumptions on the development of expressing surprise in social contexts.

Study 1 Part 1 – the Production of Children's Expression of Surprise

Method

Participants. In total, 90 children participated in this study. We selected participants from two age groups: 8-year-old children (42 children in total, 45% girls) and 11-year-old children (48 children in total, 56% girls). All participants had to play a knowledge quiz in self-selected pairs. These pairs were randomly divided across two experimental conditions half of the pairs played the game in a competitive context and half of them in a collaborative context. The experiment was conducted in two primary schools in Zoetermeer, the Netherlands. Beforehand, we informed parents of participating children about the experiment and asked their signed permission for their child to participate.

Stimuli. The knowledge quiz consisted of 30 questions, which participants had to answer by taking turns, such that each of them responded to 15 questions. Both participants saw a question on their respective screens, but only one participant had to give an answer, while the other just listened to the response. For the next question in the list, they changed roles so that the other participant would answer a question, and vice versa. The series of questions was partly adapted from earlier research by Krahmer and Swerts (2005) and was selected from the children's edition of the game Trivial Pursuit and a Dutch version of the "Wechsler Intelligence Scale for Children" (WISC). We

made sure that both easy and hard questions were included, in order to elicit both correct and incorrect answers. An example of a question, which is likely to be perceived as easy, is "Which month follows March?"; an example of an expectedly difficult question is "What is glass made from?"

The participants were asked to sit behind two separate computer screens, which were arranged in such a way that participants were not able to see each other or each other's computer screen, but they were able to hear each other's answers. A thin curtain between the participants prevented visual contact between the participants (see Figure 2.2). To prevent interaction, they were told that any form of talking was reprimanded by subtracting game points. Participants were led to believe that they both saw the same list of questions on their computer screens. However, unknown to the participants, in order to elicit a surprise reaction, the questions posed occasionally were different for the two participants. In these manipulated sequences, the question posed to the answering participant was either more difficult or easy than the question posed to the listening participant. The levels of difficulty for answering the questions were pretested. According to Itti and Baldi (2006), surprise can only be elicited in situations that mark both uncertainty and subjective expectations. Our knowledge quiz creates situations that meet both requirements. The series of questions feeds participants' expectations and participants are clearly uncertain about outcomes. In this way, we could manipulate various questions to create situations in which the speaking participant's answer was unexpectedly correct, or unexpectedly incorrect, according to the knowledge of the listening participant. More specifically, we aimed to elicit reactions of two types of surprise.

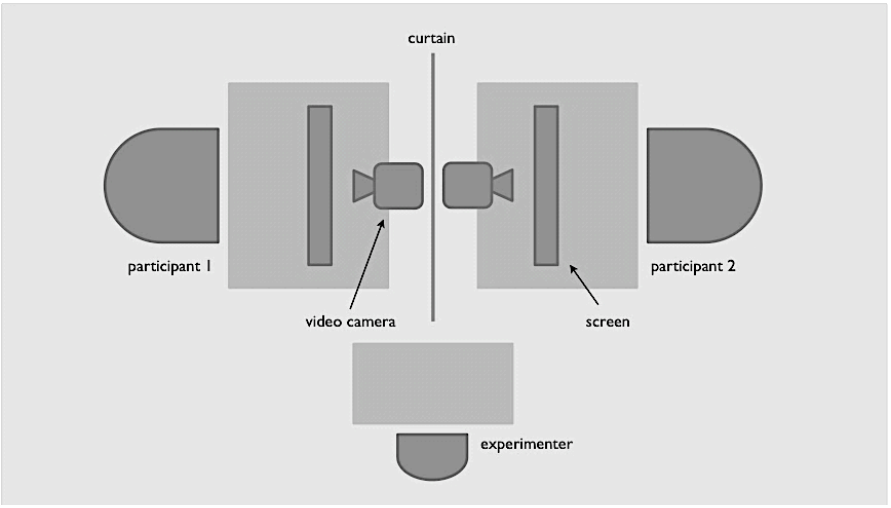

Figure 2.2. Experimental setting.

First, we manipulated questions in such a way that participants would be surprised because of an unexpectedly correct answer. We showed the answering participant a question that was easy to answer, while the listening participant saw a question that was extremely difficult to answer. For example, the answering participant was given the question: "Which year follows 1933?", a question that is easy to answer. However, simultaneously, the listening participant saw the question: "In which year was the city Tilburg established?" which is an extremely difficult question, certainly for 8- or 11-year-old children. So to the listening participant, it would probably come as a surprise that his/her partner would give a quick and confident sounding response to this complex question (this example is later referred to as manipulation example 1).

Second, we also tried to elicit surprise, caused by an unexpectedly incorrect answer of the team mate/opponent. We showed an easy question to both answering and listening participants, but these questions were not similar. For example, the answering participant was given the question: "Which farm animals roll in the mud?" while the listening participant saw the question: "Which animals live in an aquarium?" So to the listening participant, it would probably come as a surprise that his/her partner would give an incorrect answer to this easy question (this example is later referred to as manipulation example 2).

For each pair of participants, we manipulated four questions to elicit surprise caused by an unexpectedly correct answer and four questions to elicit surprise caused by an unexpectedly incorrect answer. This means that each participant answered two questions unexpectedly correct and two questions unexpectedly incorrect, and listened to two unexpectedly correct answers and two unexpectedly incorrect answers.

Procedure. Before the start of the quiz game, the pairs of participants were randomly assigned to a competitive or collaborative condition. Participants were given instructions by the experimenter who told them that they were going to play a knowledge quiz together and that they had to take turns in answering the questions that appeared on a screen. They were told to answer as many questions correctly as possible together (collaborative context), or that they were playing against each other, and that they had to compete to get the most correct answers individually (competitive context). To emphasize this social context, participants wore same colored T-shirts in the collaborative context, and T-shirts with different colors in the competitive context. Apart from the color of the T-shirts and the introduction given by the experimenter, the procedure was exactly the same for both conditions.

The participants' face and upper body were filmed by a video camera, which was placed next to a computer screen. After each answer, both participants had to indicate how certain they were about the correctness of either their partner's or their own answer. In this way, we could see whether participants indeed thought that the answers given by their opponent or team member were correct or incorrect, and check whether our manipulations worked properly. Participants had to indicate this certainty of correctness on a five-point Likert scale, using specific facial representations of the items. For example, a very unhappy face (corners of the mouth pulled down) represented a score of 1 (very uncertain about the correctness), and a very happy face (corners of the mouth pulled up) represented a score of 5 (very certain about the correctness). The participants were told to select the face that best represented their feeling and show it to the camera. These facial representations of Likert scales are fairly standard for studies involving children (e.g., Lockl & Schneider, 2002) and our participants acknowledged that they were easy to use.

To familiarize participants with the quiz and the social context they were in, all pairs of participants began the experiment with a training session, which consisted of ten questions with different levels of difficulty (five for each participant, without using any manipulations to elicit surprise). In the course

of this phase, the experimenter stressed the importance of trying to give a correct answer. To stimulate participants to try their best and to emphasize the social context pairs were in (competition or collaboration), they were told that (depending on the condition) the best individual or the best team of the class would receive a prize. In addition, after having participated in the experiment, all participants received a small gift (pencil and eraser) as appreciation for their contribution. Afterwards, we asked participants if they noticed anything strange during the game but none of them appeared to be aware of our manipulations.

Descriptive results

We first checked whether our manipulations to elicit surprise with different causes had worked by computing a difference score from the certainty scores of both answer-giving and listening participants. We expected these difference scores to diverge, in such a way that for unexpectedly incorrect answer manipulations, the answering participant was sure that his/her answer was correct (and for example, give a certainty score of 5), and the listening participant was sure the answer was incorrect (and for example, give a certainty score of 0, which would result in a difference score of 5). For unexpectedly correct answer manipulations, we expected the answering participant to believe that his/her answer was correct (and for example, give a certainty score of 5), and the listening participant not to know the correct answer, which means that the listening participants would have to be less certain about the correctness (and for example, give a certainty score of 3, which would result in a difference score of 2). Concerning the regular questions, we expected both participants' certainty scores to be approximately the same (for example, participants are both certain about the correctness of an answer, giving a score of 5, which would result in a difference score of 0). The distribution of difference scores could give us more insight into the implementation of our manipulations.

We used analysis of variance (ANOVA), with the surprise manipulation (baseline, reactions to unexpectedly correct answers and reactions to unexpectedly incorrect answers) as a within-subjects factor, age (8- and 11-years-old) and social context (collaboration and competition) as between-subjects factors and the difference score as dependent variable. We found an effect of the surprise manipulation, as reflected in the differences between speaker's and listener's certainty scores, $F(1, 41) = 76.74$, $p < .001$, $\eta^2_p = .65$. A Bonferroni post hoc test showed that for the baseline condition ($M = 0.24$, $SD =$

0.75), the difference in speaker and listener's certainty score is significantly smaller, compared to both surprise manipulations ($p < .001$). Moreover, the difference score for unexpectedly correct answer manipulations *(*$M = 1.58$, $SD = 0.69$) is in turn significantly smaller than for unexpectedly incorrect answer manipulations ($M = 3.05$, $SD = 1.30$, $p < .001$). We found no effects of social context ($F(1, 41) = 1.03$, *ns,* $\eta^2_p = .02$) and age, ($F(1, 41) < 1$, *ns,* $\eta^2_p = .00$) on the certainty of correctness difference scores.

Coding

After eliciting differently caused surprise reactions from our participants in collaboration and competition in two age groups, we wanted to analyze whether these factors had any effect on facial expressions. Therefore, we coded a selection of utterances for the presence of the three features belonging to the full facial display of surprise (moving eyebrows, opening mouth, and widening eyes, Ekman & Friesen, 1978) and also annotated frowning and smiling as these represented possible cues to positive or negative valence.

Stimuli. We used the same selection of video clips for coding as for the perception task described below. To keep experimental time of that perception experiment within reasonable limits, we selected 96 video clips of children listening to the answer to a question by the other participant during the quiz game, more specifically three questions per couple. For the unexpectedly correct answer manipulation, we used all video clips with reactions to the answer to the "1933" question, and for the unexpectedly incorrect surprise manipulation, we used all reactions to the answers to the "pigs in an aquarium" question, as participants' difference scores appeared to be highest for these two questions (for reactions on unexpectedly incorrect answer manipulations, at least an average score of 4, for reactions on unexpectedly correct answer manipulations, at least an average score of 2). In other words, with these particular questions, our manipulations worked as intended, and the assessment of the correctness of an answer by speakers and listeners were most different from each other (for full descriptions of these manipulations, see the production experiment's stimuli section above, example 1 and 2). As a baseline condition, we used the reactions to the answers on a third, easy, question without manipulation. The selected video clips contained the listening participants' reactions to the speaking participants' answers, from the moment the speaking participants started his or her answer, until the listening participant indicated his or her certainty score.

To control for any possible effects of the video clips' time interval, we ran a repeated measures ANOVA with the surprise manipulation (baseline, reactions to unexpectedly correct answers and reactions to unexpectedly incorrect answers), as a within-subjects factor, age (8- and 11-years-old) and social context (collaboration and competition) as between-subjects factors and time interval of the reactions (in seconds) as the dependent variable. As expected, we found an effect of cause, $F(2, 58) = 32.96$, $p < .001$, $\eta^2_p = .54$. A Bonferroni post hoc test shows that both surprise reactions take significantly longer than baseline reactions ($M = 4.53$, $SD = 1.81$, $p < .001$). However, we found no significant difference in duration between surprise reactions caused by unexpectedly correct ($M = 7.20$, $SE = 2.01$) and unexpectedly incorrect answers ($M = 7.96$, $SD = 2.98$). Neither age nor social context appeared to affect participants' reaction time (age: $F(1, 28) = 1.83$, ns, $\eta^2_p = .06$; social context: $F(1, 28) = 1.04$, ns, $\eta^2_p = .04$). For the purpose of coding, the video clips were presented without any sound and all certainty scores presented by the children on the smileys in the video clips were blurred.

Coding and annotation. Two independent coders, who were blind for experimental condition (age, manipulation and social context), manually coded all selected clips of listening participants, for the presence (coded as 1) or absence (coded as 0) of the features that represent the full facial display of surprise (raising eyebrows, dropping jaw and opening mouth) and additional valence related features (frowns and smiles). For representative examples of all coded features, see Figure 2.3. Before coding, coders had a short training phase, to make sure both coded the video clips in the same way. After coding, the Landis and Koch Kappa interpretation scale (1977) indicated substantial to almost perfect inter-coder agreement for all features (Kappa's were .84 for rising brows, .70 for eye opening, .69 for mouth opening, .95 for frowning and .79 for smiling). Inconsistent coding was discussed between the two coders until consensus was reached.

Figure 2.3. Stills illustrating the coded features with child participants (from left to right: raising eyebrows, eye widening, mouth opening, frowning, and smiling, note that presented participants can display multiple features at the same time).

Coding results

After coding, we investigated which features children use to express the two differently caused emotions of surprise and whether this differs for the two age groups and social contexts. As Table 2.1 shows, our manipulations elicited full facial displays of surprise in only 3.1% of reactions to unexpectedly correct answers and in 9.4% of the reactions to unexpectedly incorrect answers. Respectively 40.6% and 18.8% of the manipulations caused no surprise cues at all with the participants.

Table 2.1. Percentages of appearance children's (partial or full) facial display of surprise caused by (non) manipulated answers.

Facial surprise reaction	Baseline	Unexpectedly correct	Unexpectedly incorrect
No features	81.3%	40.6%	18.8%
Partial display of surprise (1 or 2 cues)	18.8%	56.3%	71.9%
Full facial display of surprise	0.0%	3.1%	9.4%

Second, we used an ANOVA for analyzing the appearance of features belonging to Ekman and Friesen's (1978) full facial display of surprise in the video clips, with cause of surprise (baseline, reactions to unexpectedly correct answers and reactions to unexpectedly incorrect answers) as a within-subjects factor and age (8 and 11) and social context (collaboration and competition) as between-subjects factors. Analysis of the full facial display of surprise (by adding up scores of separate features, with a minimum score of zero, no features present, and a maximum score of three, all features present) shows an effect of the cause of surprise, $F(2, 56) = 12.06$, $p < .001$, $\eta^2_p = .30$. A post hoc test (Bonferroni method) reveals a significant difference in the appearance of features belonging to the full facial display of surprise between the surprise manipulations and the baseline condition ($M = .25$, $SD = 0.59$, $p < .001$). However, the difference in the use of these features between surprises caused by unexpectedly correct and unexpectedly incorrect answers was not significant (unexpectedly correct answers: $M = .91$, $SD = 0.88$; unexpectedly incorrect answers: $M = 1.09$, $SD = 0.78$). Moreover, neither age nor social context affected the overall appearance of surprise features, (age: $F(1, 28) < 1$, *ns,* $\eta^2_p = .03$; social context: $F(1, 28) < 1$, *ns,* $\eta^2_p = .03$).

When we take a closer look at the surprise features, only mouth opening appears to be affected by the surprise manipulation. Table 2.2 shows that both brow movement and eye widening are not significantly more present in manipulated conditions than in the baseline condition. Concerning the valence related features; the distribution of frowns is affected by the nature of the manipulation. In response to a baseline answer, only 3.1% of the children frowned. However, in a manipulated condition, respectively 21.9% and 56.3% used frowning in their facial expression. Smiles were more or less equally distributed among all conditions.

Table 2.2. Percentages of appearance features in baseline condition, unexpectedly correct and unexpectedly incorrect manipulations for children.

Features	Baseline	Unexpectedly correct	Unexpectedly incorrect	Cochran's Q
Brows up	12.5%	28.1%	21.9%	2.923
Eye widening	6.3%	21.9%	28.1%	4.875
Mouth opening	6.3%	40.6%	59.4%	17.840***
Frowning	3.1%	21.9%	56.3%	24.778***
Smiling	65.6%	56.3%	62.5%	1.000

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

In the first study, we conducted an experiment in which pairs of children had to play a knowledge quiz. During this quiz, we tried to elicit facial expressions of surprise by manipulating the situation in which a partner's answer would be unexpectedly correct or unexpectedly incorrect.

First, we checked whether our manipulation worked. Comparing the certainty scores from both manipulated questions and regular questions strongly suggests that the manipulations generated situations that differed regarding the experienced degree of surprise. For unexpectedly incorrect answer manipulations, there was a large difference in certainty scores, surprise caused by an unexpectedly correct answer resulted in a smaller discrepancy between participants' certainty scores, and finally, certainty scores for baseline answers hardly differed from each other. Moreover, to control for any possible effects of time interval, we checked if the length of the reactions was affected by cause, context, or age. We only found a significant

difference between baseline and manipulated (surprised) reactions; as expected, baseline reactions were shorter than manipulated reactions. We found no effects of cause, context, or age on duration.

Second, we coded the video clips for features belonging to the full facial display of surprise (Ekman & Friesen, 1978) and additional valence related cues. We wanted to know whether the cause and context of surprise had any effect on the facial expressions of 8- and 11-year-old children. Similar to earlier studies (e.g., Reisenzein et al., 2006) a full facial display of surprise was rarely shown, as illustrated by Figure 2.3, in which stills are presented of children using primarily features of distress and disappointment. Only a small percentage (respectively 3.1% and 9.4% caused by unexpectedly correct answers and unexpectedly incorrect answers) of our participants used all three features to express their surprise. Note that this number is still considerably higher than earlier studies have managed to elicit. We believe that this comparatively higher number of full facial displays of surprise is due to the nature of the used paradigm to elicit surprise reactions (i.e., a natural way of eliciting emotions in a social, game-like setting). When we look at possible effects of cause, context, and age, we only found a significant difference in the frequency of use of the facial features between baseline and manipulated reactions. As expected, surprised participants expressed more surprise related features, compared to baseline conditions. However, we found no effects of cause, social context, and age.

A closer look at the surprise related features reveals that only opening of the mouth is used more in surprise manipulations, even when a difference in cause does not seem to affect the use of this feature. The only feature that does seem to be affected by cause of the surprise is frowning. This feature has not been listed as one of the features belonging to the full facial display of surprise according to Ekman and Friesen (1978). Still, the presence of this feature in surprise displays might implicate the valence related character of the emotion of surprise and might clarify the low number of full surprise displays found in earlier studies.

In this coding study, we managed to elicit facial displays of surprise, but so far did not find effects of cause and social context. Still, it is conceivable that such contextual factors are important for expressing surprise. According to Feldman Barrett, Mesquita, and Gendron (2011), facial features might carry affective information, but emotional meaning is rather contingent on context. Moreover, it might be possible that our broad transcription of facial characteristics was not able to capture subtle differences in expressions due to

the context. So in addition, we used the coded video clips for conducting a perception test.

Study 1 Part 2 – the Perception of Children's Expression of Surprise

Method

Participants. Thirty students from Tilburg University (16 female) participated as judges in the perception experiment (age range: 18- 48 years old, M = 22.07, SD = 5.42).

Stimuli. The same 96 video clips that were coded for the presence or absence of surprise features in the production study were used in the perception test as stimuli.

Procedure. All 96 video clips were shown to the participants in one of two random orders, to compensate for any order effects due to habituation or fatigue. First, the identification number of the stimulus was presented (1 through 96), followed by the actual stimulus. During an inter-stimulus interval of three seconds the screen turned black, and participants were asked to rate the child's level of surprise, on a seven-point Likert scale. To ensure that participants were familiar with the perception task, the experiment was preceded by a short training phase. The scores of the participants were very consistent, as evidenced by the Cronbach's alpha of .96 that signals a high inter-coder reliability.

Results

We conducted a 3 x 2 x 2 ANOVA with cause of surprise (baseline, reactions to unexpectedly correct answers, and reactions to unexpectedly incorrect answers), children's age (8- and 11-years-old) and social context (collaboration and competition) as within-subjects factors and the perceived level of surprise as dependent variable.

We found a main effect of social context on the perceived level of surprise, $F(1, 29) = 72.02$, $p < .001$, $\eta^2_p = .71$. Competing children ($M = 3.93$, $SD = 0.48$) were rated overall as more surprised than collaborating children ($M = 3.48$, $SD = 0.51$). We also found an effect of cause of surprise on the perceived level of surprise, $F(2, 58) = 103.25$, $p < .001$, $\eta^2_p = .78$. A Bonferroni post hoc test showed that children in the baseline condition ($M = 3.01$, $SD = 0.54$) were perceived to be less surprised than the children in both surprise manipulation

conditions (p < .001). Children who were surprised by an unexpectedly incorrect answer (M = 4.54, SD = 0.64) were perceived to be more surprised than children who were surprised by an unexpectedly correct answer (M = 3.57, SD = 0.64, p < .001). Age did not have an effect on the perceived surprise level, $F(1, 28) = 3{,}49$, *ns*, $\eta^2_p = .11$.

We found two interaction effects involving cause of surprise. First, there is an interaction between age and cause of surprise, $F(2, 58) = 54.56$, $p < .001$, $\eta^2_p = .65$. After running post hoc analyses (Bonferroni method), in which we looked at the perception of surprise for both age groups separately, we did not find a significant difference in perceived surprise for the 8-year-old children between the baseline condition and the unexpectedly correct answer manipulation, but only a difference between these two conditions and the unexpectedly incorrect answer manipulation (p < .001). For the perceived surprise of 11-year-old children, there was a significant difference between all three conditions (p < .001), see Figure 2.4.

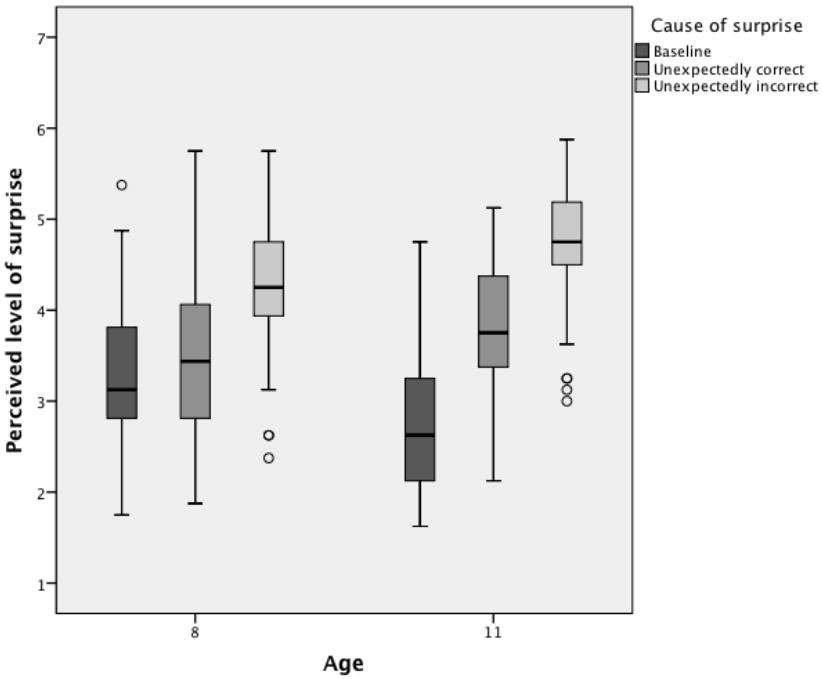

Figure 2.4. Perception of children's surprise as a function of age and cause of surprise.

Second, we found an interaction effect between social context and cause of surprise on the perceived level of surprise, $F(2, 58) = 13.38$, $p < .001$, $\eta^2_p = .32$. Post hoc analyses (Bonferroni method) reveal that in collaboration, there is a significantly larger difference between the perception of surprise reactions caused by unexpectedly correct and unexpectedly incorrect answers than in competition ($p < .001$). In the competitive context, children are, overall, perceived to be more surprised than in the collaborative context ($p < .001$), see Figure 2.5.

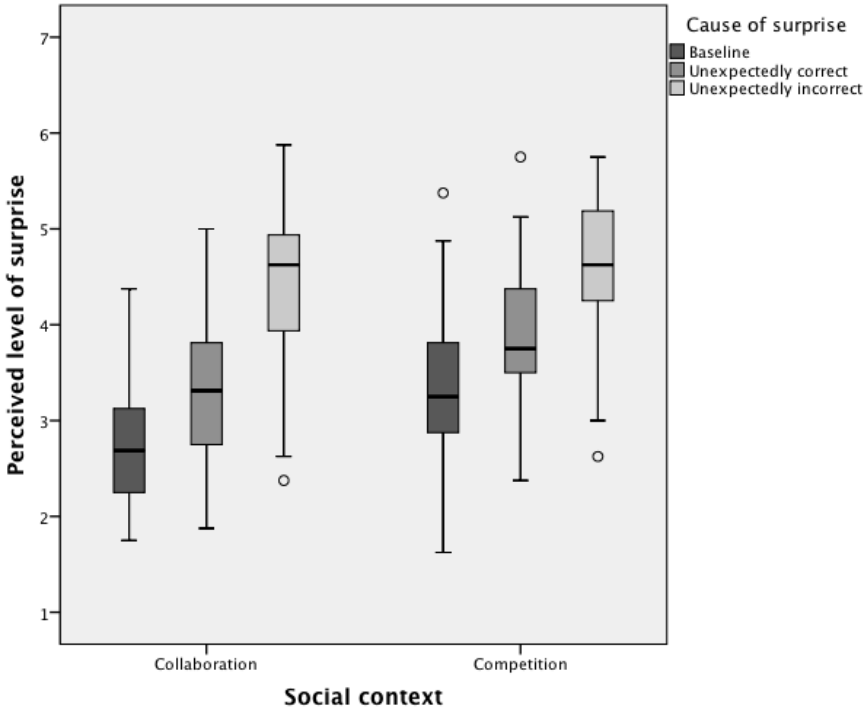

Figure 2.5. Perception of children's surprise as a function of social context and cause of surprise.

Finally, we compared the outcomes of the coding study with the outcomes of the perception test. Significant correlations were found between the perceived level of surprise and the presence of the full facial display ($r = .48$, $p < .01$) and between the perceived level of surprise and all separate features,

with an exception of eye widening (brow up: $r = .46$, $p < .01$; eye widening $r = .01$, *ns*; mouth opening: $r = .46$, $p < .01$; frowning: $r = .45$, $p < .01$; smiling: $r = .29$, $p < .01$). Apparently, eye widening does not account for a higher level of perceived surprise.

Discussion

The perception test showed that surprise is perceived differently between the three contexts (baseline context, reactions to unexpectedly correct answers, and reactions to unexpectedly incorrect answers). We found that surprise caused by unexpectedly correct answers was signaled less clearly as such than surprise caused by unexpectedly incorrect answers. Furthermore, we found that 11-year-old children's expressions of surprise were perceived to be more distinct among the different conditions. This could mean that children express their surprise more accurately as they grow older. We also found that competing children are perceived to be more surprised than collaborating children, at least for the baseline condition and surprise caused by unexpectedly incorrect answers. This may be due to the fact that children in competition are more aware of their social environment, because although participants were not able to see each other, the urge for self-presentation might be more important in this context. Expressing surprise might feel beneficial for the players' progression in the game. By conveying surprise, competing participants might cause their opponent to feel uncertain about their chances of winning. We did not find an interaction effect between age and social context. We can conclude that for both age groups, the social context appears to have an important effect on the perception of surprise displays. However, this finding is at odds with the fact that social context did not affect the use of coded features (rising eyebrows, widening eyes, dropping jaw, smiling, and frowning). Still, when comparing the coded data with the outcomes of the perception test, results show a strong correlation between the perceived level of surprise and the presence of the full facial display and almost all separate features.

Given the selection of our participants, the effect of age was explored only with data from children in two age groups (8 and 11 year old). Therefore, we have to be careful about making generalizations about the effect of development on expressing surprise. It could be that children in our researched age groups are not as distinct in their social skills as we thought they would be, and that they do not differ in their knowledge about the display rules in collaboration and competition yet. To elaborate on how social

development affects the expression of surprise, we decided to include an age group of people who are more likely to be more developed socially, namely adults. To our knowledge, earlier research on adult's expressions of surprise never focused on different social contexts. Therefore we conducted a second study, in which we performed the same two experiments (production and perception) as in the first study, but now with adult participants.

Study 2 Part 1 – the Production of Adults' Expression of Surprise

Method

Participants. In this second production experiment, 44 students of Tilburg University participated (39% female), with a mean age of 21 (SD = 2.20). Again, participants were asked to play a trivia quiz game in self-selected pairs, which were randomly assigned to either the collaborative or the competitive condition.

Stimuli. For creating a game situation as natural as possible, we adjusted the original quiz game to the cognitive and educational level of our adult participants. Therefore, we used more challenging questions in this second experiment, which we partly adapted from earlier research by Swerts and Krahmer (2005), who selected questions from the game Trivial Pursuit. Again, both easy and hard questions were included, for eliciting correct as well as incorrect answers. An example of an easy question we used in the quiz is: "How many degrees are in a circle?" and an example of a difficult question is "Who wrote Faust?"

Again, we manipulated a number of questions for eliciting surprise reactions, caused by unexpectedly correct and unexpectedly incorrect answers, in a similar way as in the children's study. An example of a manipulation to elicit surprise by an unexpectedly correct answer is when the answering participant was given the question: "Which year follows 1933?" (easy to answer). However, simultaneously, the listening participant saw the question: "In which year was Den Bosch provided with city laws?" (extremely difficult to answer). So to the listening participant, it would probably come as a surprise that his/her partner would give a quick and confident sounding response to this extremely difficult question.

An example of a manipulation for eliciting surprise caused by an unexpectedly incorrect answer is when the answering participant was given the question: "On which continent is Cambodia located?" while the listening

participant saw the question: "On which continent is Paris located?" So to the listening participant, it would probably come as a surprise that the other participant would give an incorrect answer to a relatively easy question. Similar to the child experiment, we manipulated four questions to elicit a surprise reaction to a unexpectedly correct answer and four questions to elicit a surprise reaction to an unexpectedly incorrect answer for each pair of participants.

Procedure. The procedure of the production experiment with adults as participants was exactly the same as the production experiment with children as participants, except for three things; first, we did not give adult participants t-shirts to wear. We imagined changing shirts would make them feel uncomfortable. Therefore, we gave participants differently colored key chains to wear to emphasize the competitive context. In the collaborative context we gave them key chains with identical colors. Second, adult participants were not to give their certainty scores on answers using facial representations of items on a five point Likert scale, as child participants were supposed to do. Adult participants were asked to give their certainty score on a five point Likert scale by form, instead of by facial representations. Finally, we rewarded adult participants with extra study credits, instead of pencils and erasers. After the experiment, we asked participants if they noticed anything strange during the game and if they knew what the aim of the experiment was. All participants indicated that they were not aware of the aim of the experiment, and that they did not notice anything odd, while playing the game. When we actually informed them about the manipulations, only one participant endorsed the unusual answers of his contestant. We checked whether his scores were abnormal, but they were not.

Descriptive results

Again, the difference scores of certainty of both listening and answering participants were computed for verifying the accuracy of the manipulations as implemented in the quiz. These certainty scores implement the thoughts about the correctness of the given answer of both the answering participant himself/herself and of the listening participant.

We conducted a repeated measures ANOVA with the surprise manipulation (baseline, reactions to unexpectedly correct answers and reactions to unexpectedly incorrect answers) as a within-subjects factor, social context (collaboration and competition) as a between-subjects factor and the

difference score as dependent variable. We found that surprise manipulation affects the difference score between speaker's and listener's certainty scores, $F(2, 40) = 30.57$, $p < .001$, $\eta^2_p = .61$. Post hoc tests (Bonferroni) showed that for the unexpectedly incorrect answer manipulations ($M = 3.24$, $SD = 1.91$), the difference in speaker and listener's certainty score is significantly larger than for unexpectedly correct answer manipulations ($p < .001$). Moreover, the difference score for unexpectedly correct answer manipulations ($M = 1.88$, $SD = 1.76$) is in turn significantly larger than for the non-manipulated, baseline questions ($M = 0.33$, $SD = 1.08$, $p < .001$). We found no effect of social context on the difference of certainty of correctness scores, $F(1, 20) < 1$, *ns*, $\eta^2_p = .00$.

Coding

Since the method for the adults' coding study was almost the same as for the children's coding study, we refer to the corresponding section for a detailed description of selection of stimuli, coding and annotation. However, since the number of adult participants was smaller in the production study, and we wanted to coding the same amount of surprise utterances as with the children study, we decide to use all manipulation questions of the adults instead of only one per condition (as we did in the children study). Still, with these questions, participants' difference scores were at least an average score of 4 or higher for reactions to unexpected incorrect answers, and at least an average score of 2 or higher for reactions to unexpected correct answers, similar to the utterances used in the children's study. Again, we controlled for any possible effects of the video clips' time interval, by running a repeated measures ANOVA with the surprise manipulation (baseline, reactions to unexpectedly correct answers and reactions to unexpectedly incorrect answers) as a within-subjects factor, social context (collaboration and competition) as a between-subjects factor and time interval of the reactions (in seconds) the dependent variable. We found an effect of cause, $F(2, 60) = 48.12$, $p < .001$, $\eta^2_p = .62$. A Bonferroni post hoc test shows that both surprise reactions take significantly longer than baseline reactions ($M = 3.56$, $SD = 1.11$, $p < .001$). Moreover, we found a significant difference in duration between surprise reactions caused by unexpectedly correct ($M = 7.28$, $SD = 2.19$) and unexpectedly incorrect answers ($M = 5.52$, $SD = 1.44$, $p < .001$). There was no effect of social context on reactions' time interval, $F(1, 30) = 3.09$, *ns*, $\eta^2_p = .93$.

The Landis and Koch Kappa interpretation scale (1977) indicated acceptable inter-coder agreement for all features (Kappa's were .84 for raising eyebrows, .64 for eye opening, .69 for mouth opening, .84 for frowning and .76

for smiling). Inconsistent coding was discussed until consensus was reached. For representative examples of the coded features for adults, see Figure 2.6.

Figure 2.6. Stills illustrating the coded features with adult participants (from left to right: raising eyebrows, mouth opening, eye widening, frowning, and smiling, note that presented participants can display multiple features at the same time).

Coding results

After coding, we analyzed participants' expressions for Ekman and Friesen's (1978) full facial display of surprise. As Table 2.3 shows, our manipulations elicited in only 6.3% of reactions to unexpectedly correct answers a full facial display of surprise. None of the participants expressed a full facial display of surprise as a reaction to an unexpectedly incorrect answer. Moreover, respectively 34.4% and 37.5% of the participants used no surprise features at all in their reaction to unexpectedly correct and unexpectedly incorrect answers.

Table 2.3. Percentages of appearance adults' (partial or full) facial display of surprise caused by (non) manipulated answers.

Facial surprise reaction	Baseline	Unexpectedly correct	Unexpectedly incorrect
No features	84.4%	34.4%	37.5%
Partial display (1 or 2 cues)	15.6%	51.4%	62.5%
Full facial display	0.0%	6.3%	0.0%

Subsequently, we studied if the expression of surprise depends on how it is caused and on the social context participants find themselves in. We used analysis of variance (ANOVA), with surprise manipulation as a within-subjects factor (baseline reactions, reactions to unexpectedly correct answers, and reactions to unexpectedly incorrect answers), social context (collaboration and competition) as a between-subjects factor and the presence of several cues (eyebrow rising, eye widening, opening mouth, frowning, and smiling) as dependent variables. When focusing on the full facial display of surprise (by adding up scores of eyebrow rising, eye widening and opening mouth), we find an effect of surprise manipulation, $F(2, 60) = 13.57$, $p < .001$, $\eta^2_p = .31$. A Bonferroni post hoc test shows that there is a significant difference in the use of features belonging to the full facial display of surprise between the surprise manipulations (unexpectedly correct answer manipulation: $M = 1.06$, $SD = 0.96$; unexpectedly incorrect answer manipulation: $M = 0.81$, $SD = 0{,}72$) and the baseline condition ($M = 0.19$, $SD = 0.46$, $p < .001$). However, there was no significant difference between surprises caused by unexpectedly correct and unexpectedly incorrect answers for the use of the full facial display of surprise features. Moreover, we found no effect of social context on the presence of surprise features, $F(1, 30) = 2.13$, *ns*, $\eta^2_p = .07$.

When we analyze the features belonging to the full facial display of surprise separately, we find significant differences in the distribution of upward brow movements ($p < .001$) and eye widening ($p < .001$) in reactions to baseline,

unexpectedly correct and unexpectedly incorrect answers. Table 2.4 shows that these two features are used more in manipulated conditions than in baseline conditions. This is not the case for mouth opening; participants did not use this feature of the full facial display of surprise (Ekman & Friesen, 1978) in the manipulated surprise conditions more than in the baseline condition. Regarding the valence related features; we find that the use of smiles is equally distributed among the three conditions. Participants frowned significantly more in reaction to manipulated answers than to baseline answers.

Table 2.4. Percentages of appearance features in baseline condition, unexpectedly correct and unexpectedly incorrect manipulations for adults

Features	Baseline	Unexpectedly correct	Unexpectedly incorrect	Cochran's Q
Raising eyebrows	3.1%	40.6%	21.9%	12.706**
Eye widening	3.1%	40.6%	37.5%	14.778** *
Mouth opening	12.5%	25.0%	21.9%	1.733
Frowning	0%	34.4%	37.5%	13.300** *
Smiling	43.8%	21.9%	34.4%	3.524

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

We partly replicated the children production experiment with adults. All questions were adjusted to their cognitive and educational level of the latter group, including the manipulated questions. Therefore, we needed to know if the manipulations worked with adults in the same way as with the child participants, by comparing the certainty scores of listening and answering

participants. Again, in our manipulated conditions, the certainty scores for listeners and answerers differed more than in the control condition. Moreover, unexpectedly incorrect answer manipulations caused a larger difference in certainty scores than unexpectedly correct answer manipulations. Apparently, our manipulations worked in such a way that adult participants were also misled by the answers and therefore may have caused a surprise reaction with listening participants. Again, to control for possible effects of video clips' time intervals, we checked if the length of the reactions was affected by cause or social context. Similar to the children's study, we only found a significant difference between baseline and manipulated (surprised) reactions; as expected, baseline reactions were shorter than manipulated reactions. We found no effects of cause or social context.

Next, we coded the presence of the full facial display of surprise (Ekman & Friesen, 1978) in all 96 video clips containing reactions of listening participants, with an equal distribution of surprise conditions (baseline, caused by unexpectedly correct answers, and caused by unexpectedly incorrect answers) and social context (collaboration and competition). Compared to the child participants in the first study, adults showed even less full facial surprise displays (Ekman & Friesen, 1978). Only 6.3% of all participants showed a full facial display as a reaction to an unexpectedly correct answer. No full facial displays of surprise were shown as a reaction to unexpectedly incorrect answers. When statistically checked, we found an effect of surprise condition on the amount of features used. It appeared that participants showed more features of the full facial display of surprise in reaction to surprise manipulated answers, then in reaction to baseline answers. However, we found no difference between surprise caused by unexpectedly correct answers and surprise caused by unexpectedly incorrect answers. Apparently, cause of surprise does not affect the presence of the coded features.

When we examined the used features more closely, it appeared that both upward brow movements and eye widening are more often exploited in situations in which surprise reactions were elicited, compared to baseline situations. Our analyses do seem to imply an effect of cause for raising eyebrows. Participants raise their eyebrows more frequently in reaction to unexpectedly correct answers than in reaction to unexpectedly incorrect answers. We did not find opening of the mouth to be used more often in surprise conditions than in baseline conditions, which is, according to Ekman and Friesen (1978), the third feature of the full facial display of surprise.

Another cue that we found significantly present in surprise manipulations was frowning, although there appeared to be no effect of cause. Participants frowned more in a surprise-manipulated condition, but their actions were not affected by the cause of the emotion. Again, the valence related character of the emotion of surprise might be implied by the presence of frowning in surprise displays.

Similar to the child experiment, we did not find any effect of the social context on the use of full facial surprise features. Again, it could be that surprise is perceived differently than with only these five features or maybe our coding system was too crude to capture subtle variations. So, we decided to conduct a perception test using the same video clips as in for the coding.

Study 2 Part 2 – the Perception of Adults' Expressions of Surprise

Method

Participants. 31 students from Tilburg University (26 female) participated as judges in the perception experiment (age range: 18- 60 years old, M = 23.23, SD = 7.16). None of the judges had participated in the perception task of the first study.

Stimuli. We used the same 96 video clips that were coded for surprise features in the first part of the adult study in the perception test as stimuli.

Procedure. Since the method for the adults' perception experiment was exactly the same as for the children's perception experiment, we refer to the corresponding section for a detailed description. Again, the scores of the participants were very consistent, as shown by the Cronbach's alpha of .98 that signals high inter-coder reliability.

Results

We conducted an ANOVA with cause of surprise (baseline, reactions to unexpectedly correct answers, and reactions to unexpectedly incorrect answers), and social context (collaboration and competition) as within-subjects factors and the perceived level of surprise as dependent variable. We found two main effects. First, it appeared that the perceived level of surprise of quiz players was affected by the surprise manipulation, $F(2, 60) = 351{,}83$, $p < .001$, $\eta^2_p = .92$. Post hoc analyses (using the Bonferonni method) revealed that adults were perceived as more surprised when they were actually in a surprise

condition than when they were not (baseline condition: M = 2.11, SD = 0.49, p < .001). Moreover, quiz players in the surprise caused by an unexpectedly incorrect answer condition (M = 4.14 SD = 0.45) were perceived to be more surprised than adults in the surprise caused by an unexpectedly correct answer condition (M = 3.92, SD = 0.45, p < .001). Second, we also found a main effect of social context on the perceived level of surprise, $F(1, 30) = 127.58$, p < .001, η^2_p = .81. Collaborating participants (M = 3.67, SD = 0.41) were rated as more surprised than competing quiz players (M = 3.11, SD = 0.42).

However, when we look more closely at these factors (social context and cause of surprise), they appear to interact with each other, $F(2, 60) = 132.06$, p < .001, η^2_p = .82. Post hoc analyses (Bonferonni) showed no significant effect of social context on the perceived level of surprise for both baseline and the unexpectedly correct answer manipulation. However, social context does affect the perceived level of surprise in unexpectedly incorrect answer manipulated conditions. It appears that in collaboration, participants are perceived to be more surprised in reaction to unexpectedly incorrect answers manipulations than in reactions to unexpectedly correct answers (p < .001). In competition, however, they are rated less surprised in unexpectedly incorrect answer manipulations than in unexpectedly correct answer manipulations (p < .001), as displayed in Figure 2.7.

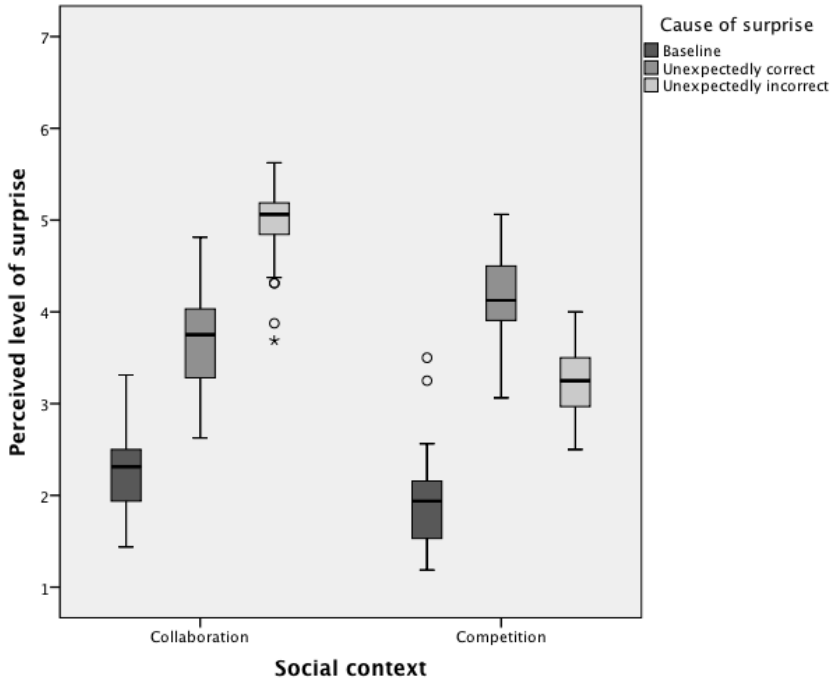

Figure 2.7. Perception of adults' surprise as a function of social context and cause of surprise.

Finally, outcomes of the coding study and the perception test were compared. We found significant correlations between the perceived level of surprise and the presence of the full facial display (r = .63, p < .001) and between the perceived level of surprise and all separate features, with an exception of eye widening (brow up: r = .47, p < .001; eye widening r = -.18, *ns*; mouth opening: r = .39, p < .001; frowning: r = .31, p < .01; smiling: r = .31, p < .001).

Discussion

In the perception test, we found that both cause and social context affect the perceived level of surprise. Moreover, there appears to be an interaction between these two factors. In the condition in which surprise was caused by an unexpectedly incorrect answer, collaborating participants are perceived as more surprised than competing participants. This could be explained by the different characteristics of collaboration and competition and the

accompanying outcomes of wrongly or correctly answered questions (Deutsch, 1949; Johnson & Johnson, 1974; Kelley & Thibaut, 1969; Roseth et al., 2008). When a collaborating participant gives an incorrect answer, his or her co-player would be put in a disadvantage as well. However, when a competing participant answers a question incorrect this would have a positive outcome for their opponent. So, the consequence of an incorrect answer is different in the two situations. Again, the outcomes of this study's perception test are at odds with the results of the coding study. Therefore, we studied the correlation between the outcomes of both studies. Strong relations were found between the perception data and the presence of the full facial display and all separate features, with an exception of eye widening. Similar to child participants, the use of eye widening with adult participants does not account for a higher level of perceived surprise.

General Discussion and Conclusion

Earlier studies have had difficulties in observing a prototypical facial display of surprise with participants (as displayed in Figure 2.1), even though these people did feel surprised (e.g., Reisenzein et al., 2006). There seems to be a discrepancy between the display and feeling of the emotion. This research aimed to get a better understanding of what factors influence surprise expressions, something that other studies so far have lacked. Since emotional expressions are commonly used to regulate social interaction (DePaulo, 1992; Ekman & Oster, 1979; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006), this research focused on two factors that may affect how people express their surprise: the cause of surprise (unexpectedly correct and unexpectedly incorrect answers) and the social context (collaboration and competition). We conducted production and perception experiments with both children and adults. In the production experiments, we measured the appearance of a surprise reaction and valence related features, by coding participants' raising of eyebrows, widening eyes and opening mouth and frowning and smiling. In the perception experiments, we asked judges to rate participants' level of surprise. In this section, we address our main findings regarding our studied factors (cause and social context), which we try to expand by elaborating on developmental differences.

First, we studied if displays of surprise differed depending on the cause of the emotion. In both studies, we manipulated various questions in the

knowledge quiz to extract reactions of surprise caused by either an unexpectedly correct or unexpectedly incorrect answer. Based on a coding of facial characteristics, we did not find support for the hypothesis that participants use different features to express a differently caused surprise. However, we did find an effect of cause in our perception studies. Judges rated reactions to unexpectedly incorrect answers as more surprised than reactions to unexpectedly correct answers. These outcomes suggest that the cause of the emotion leads to different *degrees* in surprise expressions, but not to a categorically *different* surprise expression. This assumption is in line with consistency theories, which state that unexpected events causing surprise are often negatively associated, because people need to confirm expectations so they can anticipate possible events (Cooper, 2007). While this is in principle true for both positive and negative forms of surprise, our study reveals that when the cause of the surprise is negatively framed, like an unexpectedly incorrect answer, this might elicit an even stronger expression of surprise.

Second, if it is indeed the case that negatively associated feelings of surprise lead to a more intense surprise expression, our research should reveal some interaction between cause and social context, since a competitive or collaborative context may interfere with the concept of positively or negatively caused surprise. Individual goals in collaborative contexts are very different from individual goals in competitive contexts (Deutsch, 1949; Johnson & Johnson, 1974; Kelley & Thibaut, 1969; Roseth et al., 2008) and therefore game outcomes may have different effects on players' emotional reactions. For example, in competition, an incorrect answer to an easy question probably evokes positively initiated feelings of surprise with the opponent, as an error of the opponent is actually beneficial for the other player. However, this effect should be the reverse in collaboration, as an error of a teammate is detrimental for a player's personal game outcome, and therefore he or she would experience negatively initiated feelings of surprise. In other words, the valence of the surprise reaction is determined by the combination of the cause of the emotion and its social context. When we focus on the results involving social context, such an interaction is indeed found for adults. It appears that in competition, adults' reactions to unexpectedly correct answers are perceived to be more surprised than their reactions to unexpectedly incorrect answers, while the opposite appears to be the case for surprise expressions of adults in a collaborative condition. Apparently, the valence of the surprise reaction is important for the *intensity* of a surprise expression. However, such interaction was not found regarding smiling and frowning, which are valence related

features. Participants in both studies smiled frequently, regardless of the manipulation they were in, possibly because they all indicated they enjoyed playing the quiz game. With regards to frowning, participants used this feature more for surprised expressions than for non-surprised expressions, without any effect of cause or social context. Participants just simply frowned more in all reactions to manipulated answers.

Third, with respect to the developmental focus of our studies, we did not find such an interaction between cause and social context with child participants. In general, children were more expressive in competition than in collaboration when displaying surprise. Moreover, they were perceived as more surprised by an unexpectedly incorrect answer than by an unexpectedly correct answer. Apparently, both a competitive environment and unexpectedly incorrect answers provoke surprised expressions more than a collaborative environment and unexpectedly correct answers do. It seems that due to their on-going development in the applicability of social rules (Gnepp & Hess, 1986; Piaget, 1950; Saarni, 1979), children might be less aware of specific consequences of their display acts so that these are less tuned to specific social contexts, which also fits Buck's Developmental Interactionist theory (1994). Moreover, 8-year-old children expressed their surprise more than 11-year-old children, regardless of its cause. Yet, as children grow older, expressing surprised reactions to unexpectedly correct answers seems to become more important, which is in line with our results regarding adult participants. Apparently, as people grow older, the display of surprise gets more influenced by contextual factors.

Finally, we found that children and adults use dissimilar features for showing surprise. For example, children used brow movement and mouth opening more during surprise manipulations than adults. A plausible reason for this might be that adults are more aware of the way they are being perceived by others. Consequently, they are less likely to drop their jaw than children, because they could be more aware of the fact that this might look foolish. Adults express their surprise by widening their eyes and raising their eyebrows. Evidently, we found differences between surprise expressions of children and adults. However, to make further assumptions about an age effect, statistical comparison is necessary in future research. Since we adjusted procedures for both studies to the cognitive level of the participant groups of both studies, such comparison was not desirable in our research. Still, our studies indicate differences between the two age groups in use and intensity of surprise features.

Overall, we can conclude that the expression of surprise is more than a mere reflex to an unexpected stimulus, and that it can be moderated by contextual factors. Therefore, future research should consider these factors when examining emotional expressions, such as surprise.

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3

Children's spontaneous emotional expressions while receiving (un)wanted prizes in the presence of peers

Abstract

Although current emotion theories emphasize the importance of contextual factors for emotional expressive behavior, developmental studies that examine such factors are currently thin on the ground. In this research, we studied the course of emotional expressions of 8- and 11-year-old children after winning a (large) first prize or a (substantially smaller) consolation prize, while playing a game competing against the computer or a physically co-present peer. We analyzed their emotional reactions by conducting two perception tests in which participants rated children's level of happiness. Results showed that co-presence positively affected children's happiness only when receiving the first prize. Moreover, for children who were in the presence of a peer, we found that eye contact affected children's expressions of happiness, but that the effect was different for different age groups: 8-year-old children were negatively affected, and 11-year-old children positively. Overall, we can conclude that as children grow older and their social awareness increases, the presence of a peer affects their nonverbal expressions, regardless of their appreciation of their prize.

This chapter is adapted from;

Visser, M., Krahmer, E. J., & Swerts, M. G. J. (submitted). Never look a gift horse in the mouth: Children's spontaneous emotional expressions while receiving (un)wanted prizes in the presence of peers.

Introduction

In December 2011, an enormous hit on YouTube followed when an American talk show host, Jimmy Kimmel, asked members of his audience to film their kids when they were given a Christmas present their parents were sure they would not like (Jimmy Kimmel Live! ABC 2011). While unwrapping their brand new onion or deodorant stick, most children screamed, got rather upset and eventually threw the unwanted gift away. However, when they were in the company of a sibling, the children's reactions tended to alter considerably, in that, depending on the context, the presence of the other child occasionally seemed to increase the level of frustration, or, interestingly enough, turn the child's initial disappointment into a more positive feeling. This was especially the case when their brother or sister was given a present that the child would judge as a (slightly) better or worse alternative. Figure 3.1 displays a still of one of the Jimmy Kimmel videos, and shows a typical example of a boy who appeared to be relatively excited about the Christmas present he received, a well-sized potato, as he seemed to judge this as a better gift than his older brother's, who got paper letters spelling "3DS" (which is the name of a then popular game console). The Jimmy Kimmel video shows that, while his younger brother appeared to get more and more content with his gift, the older boy seemed to become more distressed with his own. Perhaps, observing the enjoyment of his younger brother was important for the boy's evaluation of his own gift.

This example demonstrates that the presence of a peer may urge children to express their feelings more intensely, in either a positive or negative direction. It is likely that if both siblings in the Jimmy Kimmel fragment had been alone while unpacking their gifts, their emotional expressions would have been different, since they would not have to take each other's disappointment or enjoyment into account for the evaluation of their own present. Indeed, a review of existing theories of emotion reveals that researchers have claimed that external factors like social context may affect the way emotions are expressed (e.g., Frijda, 1986; Mumenthaler & Sander, 2012; Russell & Feldman Barrett, 1999; Scherer, 2009; Scherer, Schorr & Johnstone, 2001). However, to our knowledge, so far no studies have examined how these context-dependent emotion theories apply to the way other people's responses affect children's emotional expressions. In this study, we concentrate on three factors that may influence children's nonverbal expressions.

Figure 3.1. Still from YouTube video "Jimmy Kimmel, I gave my children a terrible Christmas present."

The first factor we consider is the presence or absence of a peer, where we examine whether this influences how children display different emotional expressions in response to disappointing or satisfying presents. In general, children may be expected to react politely (e.g., by smiling) when they receive a present, regardless of whether they appreciate it or not (e.g., Kieras, Tobin, Graziano & Rothbart, 2005). Earlier studies on this topic focused on factors like age (Cole, 1986; Garner & Power, 1986; Kieras et al, 2005; Kromm, Farber & Holodynski, 2014; Saarni, 1986), culture (Garret-Peter & Fox, 2007), the presence of parents (Zeman & Garber, 1996) and particular response strategies children may use when receiving a disappointing gift (Baaken, 2005; Tobin & Graziano, 2011). Surprisingly, to the best of our knowledge, no research has focused on the presence of peers when expressing emotions when receiving presents, although it is known that children in general tend to be more expressive when a peer is present (Shahid, Krahmer & Swerts, 2008; Shipman, Zeman, Nesan & Fitzgerald, 2003; Zeman & Garber, 1996). Therefore, in the current study, we will take the presence of peers into account when examining emotional expressions after receiving presents.

Secondly, we consider to what extent this effect of peers on children's expressive behavior interacts with age as a potential factor. Children's social

awareness is known to develop fundamentally between the age of 8 and 11 (Saarni, 1981; 1984). In the Jimmy Kimmel example, the likability of the gift seemed to affect the older sibling's emotional expressions more than those of the younger boy. Perhaps, the latter did not consider the potato to be the most desirable gift, but he might just have been less aware of his brother's emotional state than vice versa. In view of theories of developmental differences in social awareness, we may expect older children to be more affected by the presence of a peer than younger ones in their emotional responses (e.g., Ekman, 1992; Piaget, 1950; Saarni, 1984;). Indeed, in earlier studies, we found that for 8-year-old children, the social context they found themselves in was of less relevance for the way they expressed their emotions than it was for 11-year-old children (Visser, Krahmer & Swerts, 2014a; 2014b). The current study aims to further explore whether 8-year-old children would express their emotions differently from 11-year-old children, as a function of the event that leads to this emotion (receiving a disappointing or a satisfying present) and the context (in the absence or co-presence of a peer).

Finally, we explore how these emotional expressions may change in the course of a child's response, where we are specifically interested in the extent to which changes in their assessment of the social context has an impact on the child's expressive behavior. The Jimmy Kimmel example demonstrated that children's initial reaction may be different from their later reaction, which appeared to depend on the fact that they became more aware of their peer's reaction to their Christmas gift. Indeed, emotional expressions are not static experiences, but progress over time (Scherer, 2009). The relative influence of different factors may change in the course of emotional reactions, as people reconsider motives for expressing their emotions in a certain way (Banse & Scherer, 1996; Scherer, 2009). Therefore, we examine how children's expressions change as a function of how they assess their social context, in particular when they compare their own present with the one another person has just received. We operationalize this by focusing on participants' expressive behavior before and after they make eye contact with their peer. Before we describe the study in more detail, we first present a short discussion of relevant earlier research.

Background

A large part of earlier research on emotion has focused on discrete, basic emotions and their universal character (e.g., Darwin, 1998; Ekman, 1992; Izard,

1971; Tomkins, 1962). Discrete emotion theories suggest that children learn to express their emotions through affect programs (Ekman, 1992). These programs are directly linked to the motivational cognitive system and provide people with the ability to experience six prototypical emotions, or a combination of those, which may be accompanied by specific facial expressions (Tomkins, 1962). According to such discrete emotion theories, facial expressions of emotion are considered as universal and similar for all individuals. However, this implication has been questioned by several other (dimensional) approaches on emotions. For example, Russell and Feldman Barrett (1999) started with referring to named emotions (like anger or sadness) as prototypical episodes of core affects (affective feelings), which are not necessarily defined as "basic" or similar to all individuals. According to their theory, emotions are supposed to vary on a continuum of two factors, arousal (passiveness to activeness) and valence (unpleasantness to pleasantness).

Recently, emotion research has been focusing on subjective aspects of emotions, and various studies showed that an individual's evaluation of a situation may also have an impact on emotional expressions (e.g., Fernández-Dols & Crivelli, 2013; Mumenthaler & Sander, 2012; Scherer, 2009; Scherer & Ellgring, 2007). According to the componential model of emotions (e.g., Scherer 2009; Scherer & Ellgring, 2007), emotions are defined as on-going processes in which individuals are continuously estimating and evaluating the significance of situations for their well-being. Various characteristics of the situation may be important for emotion elicitation; for example, the novelty, pleasantness and relevance of the event determine to a large extent the valence and intensity of any emotional response. In this way, emotional expressions are not universal per se, but constructed by an individual's subjective assessment (or *appraisal*) of a situation, which depends on the validation of personal needs, goals and values (e.g., Frijda, 1986; Mumenthaler & Sander, 2012; Scherer, 2009; Scherer et al., 2001). As a result, different people may express the same emotion differently, depending on a variety of appraisals (Mumenthaler & Sander, 2012). Therefore, appraisal theorists claim that emotions are not necessarily static and universal experiences, as these may vary as a function of appraisals (Scherer, 2009; Scherer et al., 2001). In the current experimental set-up, the event of winning the first prize will most likely trigger positive appraisals, and therefore elicit emotions like happiness, while the event of receiving the consolation prize may be expected to trigger more negative appraisals and elicit emotions like disappointment.

Arguably, however, emotional expressions of happiness and disappointment may also be affected by contextual factors, such as the co-presence of a peer. In

general, the importance of contextual factors for the construction of emotional expressions has been explained in terms of push and pull effects (e.g., Banse & Scherer, 1996). Push effects of emotions represent how one's internal state influences the display of emotions. In addition, these expressions need to meet requirements of sociocultural specific models shaped by one's contextual environment, also known as pull effects. The presence or absence of addressees or spectators, and the interdependence we experience with them in specific situations partly shape this social context (Kelley et al., 2003). The concept of pull effects on emotions suggests that people express emotions in the presence of others according to certain social rules that fit the situation they are in (Ekman & Friesen, 1975). These social rules, sometimes referred to as display rules, dictate what kind of expressive behavior is socially appropriate or desirable in certain social contexts and give directions as to how, where, when, and to whom people should express their emotions (Garret-Peters & Fox, 2007). This implies that the co-presence of peers may affect children's expressive behavior when receiving disappointing or satisfying presents.

So far, studies have shown that children regulate their emotional expressions to some extent after receiving a *disappointing* present in the presence of *adults* (Baaken, 2005; Cole, 1986; Garner & Power, 1986; Garret-Peters & Fox, 2007; Kieras et al., 2005; Kromm, et al., 2014; Saarni, 1984; Tobin & Graziano, 2011). In experiments applying variations of the so-called mistaken-gift-paradigm, children were asked to rate their desire for a number of toys and books. Next, they were presented with two gift-wrapped boxes in a random order; one box contained their favorite listed item, and the other box contained their least favorite one. Facial expressions in reaction to both presents were videotaped and analyzed. Using this paradigm with children in primary school, studies found that older children smiled more than younger children, even when the present was not the one they desired, whereas younger children's expressions revealed some level of disappointment when they got the present they desired the least (Garret-Peter & Fox, 2007; Saarni, 1984).

This can be interpreted as a sign of an increased social awareness, as it shows that older children take into account what is expected from someone who gets a present and use display rules for reacting politely (e.g., by smiling) regardless of whether they appreciate the present or not. Similar studies conducted with younger participants (between the age of three and five) revealed that these children tend to show their disappointment more (Cole, 1986; Garner and Power, 1986; Kieras et al, 2005). Taken together, these results suggest that children gradually learn to regulate their emotional expressions when receiving a

disappointing present, which is in line with developmental studies concerning display rules (Gnepp & Hess, 1986; Saarni, 1981; Saarni, Campos, Camras & Witherington, 2006). According to Gnepp and Hess (1986), a developmental shift across the elementary-school years can be observed, in which children, as they grow older, demonstrate an increased understanding of the appropriateness of specific emotional expressions in specific situations. As children grow older, they are better able to adapt their emotional expressions in order to meet their personal goals and to meet the demands and expectations of their surroundings (Shipman et al., 2003). As we noted above, children's social awareness and ability to regulate their emotions develops fundamentally between the age of eight and eleven (Kromm et al., 2014; Saarni, 1981; 1984). Around the age of ten, children appear to possess the complex understanding of why certain emotional expressions are appropriate or not in specific situations (Kromm et al., 2014). Indeed, in earlier studies, we found that for 8-year-old children, the social context they found themselves in was of less importance for the way they non-verbally expressed their emotions than it was for 11-year-old children (Visser et al., 2014a; 2014b). Therefore, this study aims to further explore whether children adjust their emotional expressions as a function of the absence or presence of peers and whether this is affected by their age and abilities to regulate their emotional expressions.

Researchers studied the way children respond on disappointing presents using the mistaken-gift-paradigm by focusing on age (Cole, 1986; Garner & Power, 1986; Kieras et al, 2005), culture (Garret-Peter & Fox, 2007), and strategies children use for regulating their emotions (Baaken, 2005; Kromm et al., 2014; Tobin & Graziano, 2011; Zeman & Garber, 1996). However, to our knowledge, no research so far used a variation of the mistaken-gift-paradigm to study a possible effect of presence of peers. Still, we know that, in general, when people are rewarded for accomplishments, they evaluate and compare their compensations with those of others (e.g., Andreoni, Brown & Vesterlund, 2002). The level of fairness of outcomes tends to trigger more emotional responses than the evaluation of the outcome itself (Barry, Fulmer & van Kleef, 2004; Hamilton, 2006). Such reactions appear to be quite instinctive in nature (Brosnan & de Waal, 2003: de Waal, 1997; de Waal & Davis, 2002). De Waal and colleagues (1997; 2002; 2003), for example, conducted multiple studies in which capuchin monkeys carried out a task that was rewarded with grapes (food these primates prefer) or pieces of cucumber (food they prefer less than grapes). These monkeys rejected cucumber as a reward once they had been compensated with grapes. Even more relevant for the current research is that they also rejected cucumber once they

noticed that other monkeys were being rewarded with grapes. This shows that capuchin monkeys measure rewards in relative terms, and they evaluate and compare these rewards with those of others. Using a variation of the mistaken gift paradigm, we study whether our child participants act in a similar way.

When children compare their prize with the prize their peer was given, they may adjust the evaluation of their own prize. This implies that emotional reactions, like evaluating individual compensations with those of others, are dynamically adjusted over time, and could vary as a function of changes in social appraisals (Scherer, 2009). In other words, events are likely to continuously being re-appraised (Elsworth & Scherer, 2003). For instance, instinctive initial reactions can evolve into more regulated, socially appropriate secondary reactions. Moreover, although there is support that brief segments of expressive behavior accurately reflect expressive behavior over long durations (Ambady & Rosenthal, 1992), current research suggests that lengthening studied data segments may reveal some sort of second emotional episode in a response, especially in the case of adjusting nonverbal emotional behavior by applying display rules that fit a social context (Garret-Peters & Fox, 2007). Therefore, it is likely that within the course of receiving an unwanted gift, conflicting appraisals unfold in time (Elsworth & Scherer, 2003). In this respect, it is interesting to take the role of gaze into account, as it has been argued that the level of social contact is very much influenced by patterns in gaze behavior between people (Argyle & Dean, 1965; Borras-Comes, Kaland, Prieto & Swerts, 2014; Shahid, Krahmer & Swerts, 2012). The experience of making eye contact is an important feature for the course of emotional expressions. For example, Shahid et al. (2012) studied how eye contact between children can influence the experience of shared emotions like enjoyment or disappointment. While interacting in a game, children who had direct eye contact with each other showed more enjoyment than children who had no direct eye contact. Therefore, we will not only compare emotional reactions of children who play a game alone and in the presence of a peer, but also compare expressive behavior of the latter before and after they have made eye contact. In this way, we are able to examine how children's expressions change as a function of how they assess their social context, in particular when they compare their own present with the one another person has just received.

Taking stock, even though the unwanted gift paradigm has revealed interesting insights into how children respond non-verbally to (un)wanted gifts, to the best of our knowledge no earlier studies have looked into how children respond to wanted and unwanted gifts when they are in the presence of a peer

who receives a different (better or worse) gift. This is what we study in the current paper, where in addition, we study whether this non-verbal response is different for younger and older children, and whether there are differences between initial (before eye contact) and secondary (after eye contact) responses.

Present study

In the current study, we examined whether the presence of peers affects children's expressive behavior during the course of a positive or negative event, in particular while receiving a consolation prize (small gift) or a first prize (large gift). In the production experiment, we invited 8- and 11-year-old children to play a game alone (in which they had to compete against the computer) or in pairs (in which they had to compete against each other). The course of the game was manipulated in such a way that it always resulted in a tie, between the child and the computer or between the two children. Subsequently, the experiment leader randomly presented participating children with either the top prize or the consolation prize. In this way, we elicited particular emotional expressions, which we analyzed by conducting two subsequent perception tests, in which we asked third-party judges to rate children's level of happiness in muted video clips. Perception (or judgment) tests are known to be valuable instruments for assessing changes in socially embedded expressive behavior, as the perceptual meaning of expressions is rated by multiple judges (e.g., Kromm et al., 2014). In the first perception test, children's complete reactions upon receiving their gift were shown to third-party judges. We examined whether these reactions differed depending on whether an opponent was physically present or not for two different age groups. In the second perception test, judges were shown the reactions of children who had participated in the "in presence of a peer" condition. We split the reactions of participants into two parts, with the moment of mutual eye gaze between the opponents as the cutting point. In this way, we explored how children's expressive behavior progressed, i.e., before and after they became explicitly aware of their social context.

Data collection

Method

Participants. A total of 86 children participated in this study, of which 41 were 8 years old (M = 101.93 months, SD = 3.42 months, 27 girls) and 45 were 11 years old (M = 137.27 months, SD = 3.58 months, 23 girls). Children were randomly assigned to a game condition (competing the computer or a physically present peer) and a reward condition (receiving the consolation prize or the first prize). Table 3.1 displays the distribution of child participants across experimental conditions. The experiment was conducted at two primary schools in Zoetermeer, The Netherlands. Beforehand, the parents of the participants were informed about the experimental procedure and asked for their signed permission for their children's participation and recordings of their performance.

Table 3.1. Distribution of child participants across experimental conditions.

Age	Game context	Consolation prize	First prize	Total for each condition
8-year-olds	Computer	10	9	19
	Present peer	11	11	22
11-year-olds	Computer	11	10	21
	Present peer	12	12	24
				Total of 86 participants

Experimental procedure. Children were seated behind a table, facing the experimenter. In the "present peer" condition, they were placed next to each other. Separate cameras filmed both children's face and upper body (see Figure 3.2). Children were told that they were about to play a game: in the "computer" condition, there was only one child in the experimental room, and it had to compete against the computer; in the "present peer" condition, there were two children seated next to each other, who had to compete against each other. Apart from this, the experimental procedures were identical for both conditions. The experimenter explained that the player who would collect most game points would win the first prize, and, in the "present peer" condition, the other player would receive the consolation prize. Both gifts were wrapped in paper, so the children could not see what the prizes were. However, the wrapped gifts were

shown to them before the game started, and were markedly different, with the first prize being rather big and the consolation prize being considerable smaller (see Figure 3.3). After this introduction, children were asked to indicate how much they would like to win the consolation prize and the first prize, respectively, on a five-point Likert scale, using specific facial representations of the items, a method that is standard in research with children (e.g., Lockl & Schneider, 2002; Visser et al., 2014a; 2014b). Specifically, an unhappy face (corners of the mouth pulled down) represented a score of 1 ("I don't want this prize at all"), and a happy face (corners of the mouth pulled up) represented a score of 5 ("I want this prize very much"). Children of both age groups had no difficulties in understanding this scale.

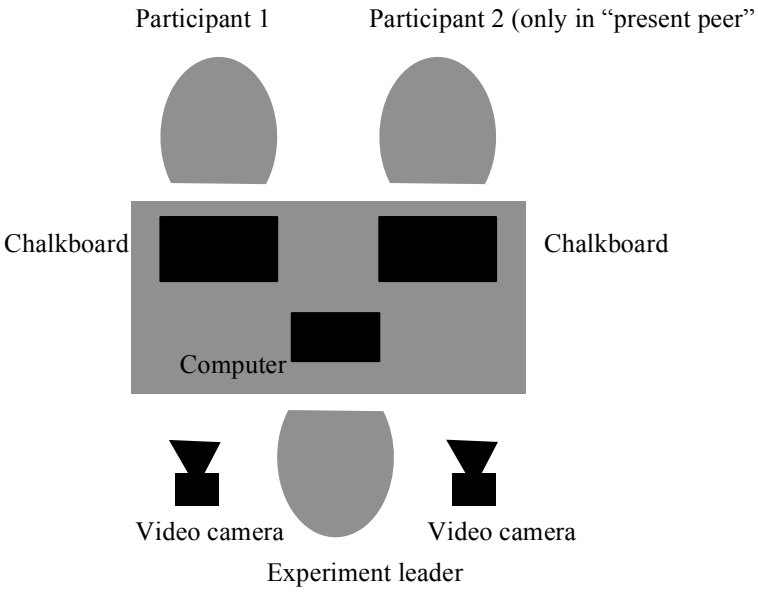

Figure 3.2. Experimental setting.

Next, children played a guessing game based on the Dutch television show "Wat vindt Nederland?" (English: "What does Holland think?"). Experiments in which children play games is developmentally appropriate for elementary school-aged children. They are familiar with playing structured games and become emotionally aroused easily in game situations because of their emphasis on the

importance of winning or losing (Taylor & Asher, 1984). The experimenter presented a number of topics (for example "favorite animal", or "favorite soda drink") and asked both players to think of the most likely answer Dutch children of their own age would give (for example, "dolphins" or "Coca Cola"). The children had to write their answer down on a small chalkboard on the table in front of them. Children were told that they were not allowed to give the same answer and the participant who was fastest could remain with their choice. The slowest participant was allowed to come up with a new answer. After the children revealed their answers to the experimenter, she pretended to search in the computer database for the correct answer and assigned one game point to the player whose answer was claimed to be most similar to the answer of most Dutch children. Unbeknownst to the children, this decision was in fact predetermined.

In total, 10 game points were to be divided between the two children (or between the child and the computer, in the "computer" condition). However, the progress of the game was manipulated: each child or pair of children was randomly assigned to one of two scripted game narrations, which always ended in a tie. The course of the game was constructed in such a way that this tie outcome was not revealed before the presentation of the tenth and final concept (in other words, after nine concepts the score was always 4-5). In this way, we tried to maximize engagement for the child participants.

When the game was completed, and had ended in a tie, the experimenter acted according to a script, and expressed doubts about what to do in this unexpected situation. After some hesitation, she decided about which gift each child received. In the "present peer" condition, one child received the first prize and the other the consolation prize. In the "computer" condition, children were awarded either the first or the consolation prize, depending on the experimental condition they were in. The experiment leader emphasized that this was a random decision, made intermittent eye contact with the child participants to monitor for understanding and otherwise remained neutral in affect so as not to influence their expressive behavior. Research has shown that the concept of fairness is mainly based on the distribution of gains (Andreoni et al., 2002; Falk, Fehr & Fischbacher, 2003). Children gradually learn social rules dictating that expressing negative emotions is unacceptable when losing against a peer who is playing fairly (Hubbard, 2001). By following a script, in which chances of winning were equally distributed for both players through the course of the game, we tried to minimize the risk of emotional expressions of frustration due to a sense of unfairness (although obviously we did expect to encounter expressions of happiness or disappointment).

Following the handing out of the prizes, the experimenter asked children to indicate how happy they were with their prize, again with the help of the facial representations of a five-point Likert scale. After this, all children were debriefed, and were told they had taken part in an experiment. We asked them if they had noticed anything strange during the game and none of them appeared to be aware of our manipulations. Regardless of the prize they had received after the game, all children were offered a small reward (not dependent on game outcome) for their participation (games and stickers). Each experimental session lasted around twenty minutes.

Figure 3.3. Representations of first prize and consolation prize (respectively the large and the small package).

Manipulation check

Before focusing on how social appraisals affect children's expressive behavior, we assessed if our game-like experimental paradigm worked as intended. For this, we analyzed children's self-reported attraction to the first prize and the consolation prize before the game and their self-reported happiness with their gift afterwards, using a five-point Likert scale. Naturally, we expected children to

indicate a higher desire for the first prize over the consolation prize, and that, accordingly, they would indicate to be happier when they had been given the first prize rather than the consolation one.

We indeed found that children reported a higher desire for the first prize (M = 4.90, SD = 0.34) than for the consolation prize (M = 2.27, SD = 1.04), $t(85) = 21.69$, $p < .001$. Apparently, all children, regardless of their age or the presence of a peer, wanted to win the first prize over the consolation prize. Moreover, children's desire scores for both the consolation prize and first prize correlated with the degree of happiness they felt after being appointed with one of the prizes (first prize: $r = .23$, n = 86, $p = .040$; consolation prize: $r = .29$, n = 86, $p = .010$). The more children wanted to have a particular prize, the happier they felt afterwards.

An ANOVA with prize, game context and age as factors and indication of happiness afterwards as the dependent variable shows that in general, children were happier when being awarded the first prize (M = 4.86, SD = 0.35) than when being awarded the consolation prize (M = 2.95, SD = 1.25), $F(1,84) = 92.41$, $p \leq 0.01$, $\eta 2p = .52$. We found no effects of age and game context, age: $F(1,84) = .27$, $p = .607$; presence: $F(1,84) = 1.21$, $p = .275$.

These results showed that the manipulation worked as intended. Children in all conditions were keener on being awarded the first prize than the consolation prize. Moreover, regardless of their age or of whether they played the game competing the computer or a physically present peer, children reported to be happier with the first price than with the consolation prize. Figure 3.4 displays stills from representative reactions of children in all experimental conditions. In the next sections, we analyzed their expressive behavior by letting third-party judges rate children's level of happiness in two perception experiments.

Figure 3.4. Stills illustrating representative examples of children's typical reactions in different experimental conditions (top left: computer/first prize; top right: present peer/first prize; bottom left: computer/consolation prize; bottom right: present peer/consolation prize).

Perception Experiment 1 – Complete Fragments

To analyze how children's expressive behavior is perceived by others, we conducted two perception experiments. In this first perception experiment, we showed third-party judges video clips of complete reactions of children who received either a consolation prize or a first prize.

Method

Participants. In total, 42 adults (24 women), with a mean age of 23 years (SD = 6.01) performed as third-party judges in this perception test. All participants

were students of Tilburg University who received partial course credits for their participation.

Stimuli. We randomly selected 72 video fragments of children's reactions who had participated in the production experiment to be used as stimuli in this perception test. We made sure that equal numbers of children were selected from the two age groups (8- and 11-year-olds), the two game contexts (competing the computer and competing a physically present peer) and the two game outcomes (first prize and consolation prize). The selected video fragments were presented to participants and contained children's reactions to the decision about the distribution of the prizes, from the moment the experimenter determined the winner of the first prize to the moment children were asked to indicate how much they appreciated their prize, with an average length of 8.13 seconds (SD = 2.27). The video clips were muted, as the verbal comments of the experimenter announcing who received which gift was likely to influence judgments' ratings.

Procedure. Participants were presented with all 72 video fragments in one of two random orders, to compensate for any order effects due to habituation. Following an identification number (1–72), the actual stimuli were presented one by one. During an inter-stimulus interval of 2.5 seconds, participants were asked to rate how happy the child appeared to be with the prize it won, on a seven-point Likert scale. To ensure that participants were familiar with the task, the experiment was preceded by a training phase containing four stimuli. Participants completed the perception task individually in a soundproof cubicle.

Results

A repeated measure ANOVA with prize, game context and age as within-subject factors, and perception of happiness as dependent variable, revealed several main effects and two- and three-way-interactions.

First, we found a main effect of prize. As expected, children who won the first prize were perceived to be happier (M = 4.73, SD = 0.52) than children who won the consolation prize (M = 4.22, SD = .58). Moreover, game context appeared to affect the perception of happiness as well. Children who played the game in the presence of a peer were perceived happier (M = 4.53, SD = 0.60) than children who played the game against the computer (M = 4.42, SD = 0.50). We found no main effect of age. Overall, participants judged 8-year-old and 11-year-old children as equally happy ($M_{8\text{-year-olds}}$ = 4.48, $SD_{8\text{-year-olds}}$ = 0.55; $M_{11\text{-year-olds}}$ = 4.47, $SD_{11\text{-year-olds}}$ = 0.55).

A significant two-way interaction was found between age and the prize children were presented with on participants' perception of children's happiness, as shown in Figure 3.5. Split analyses showed that 8-year-old children were rated as happier when they received the first prize than when they received the consolation prize ($M_{first\ prize}$ = 4.93, $SD_{first\ prize}$ = 0.51; $M_{consolation\ prize}$ = 4.04, $SD_{consolation\ prize}$ = 0.65). For 11-year-old-children, the type of prize did not affect participants' perception of their happiness ($M_{first\ prize}$ = 4.54, $SD_{first\ prize}$ = 0.57; $M_{consolation\ prize}$ = 4.40, $SD_{consolation\ prize}$ = 0.58).

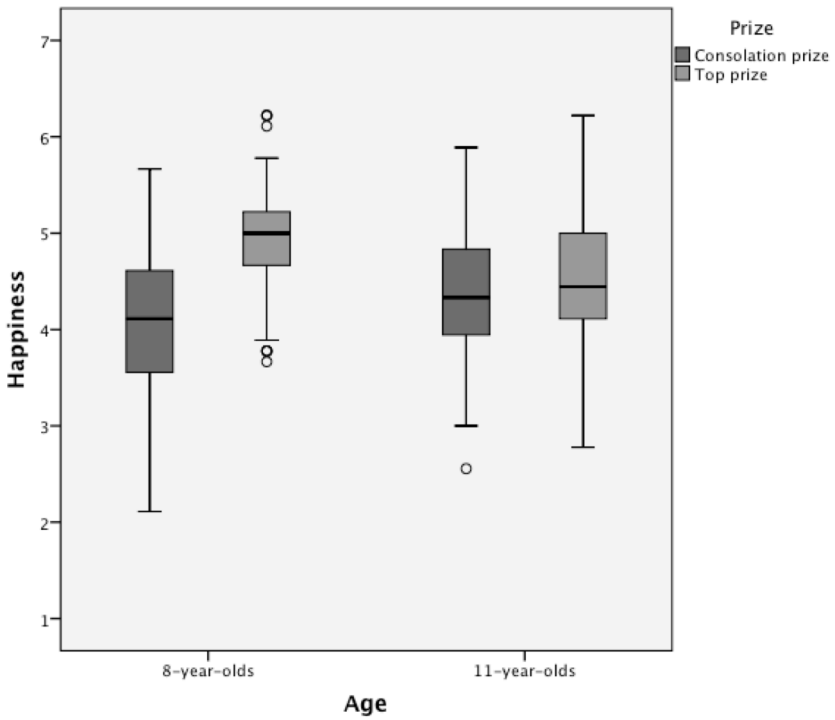

Figure 3.5. Perceived level of happiness as a function of prize and age.

Moreover, we found an interaction between children's age and game context on participants' happiness ratings. Figure 3.6 shows that when 8-year-old children were playing the game against the computer, they were generally rated as happier than when they were playing against a physically present peer ($M_{computer}$ = 4.61, $SD_{computer}$ = 0.50; $M_{present\ peer}$ = 4.35, $SD_{present\ peer}$ = 0.68). For 11-year-old children, split analyses showed an opposite effect; they were perceived

as happier when they played the game together with a physically present peer, than when competing against the computer ($M_{computer}$ = 4.23, $SD_{computer}$ = 0.53; $M_{present\ peer}$ = 4.71, $SD_{present\ peer}$ = 0.62).

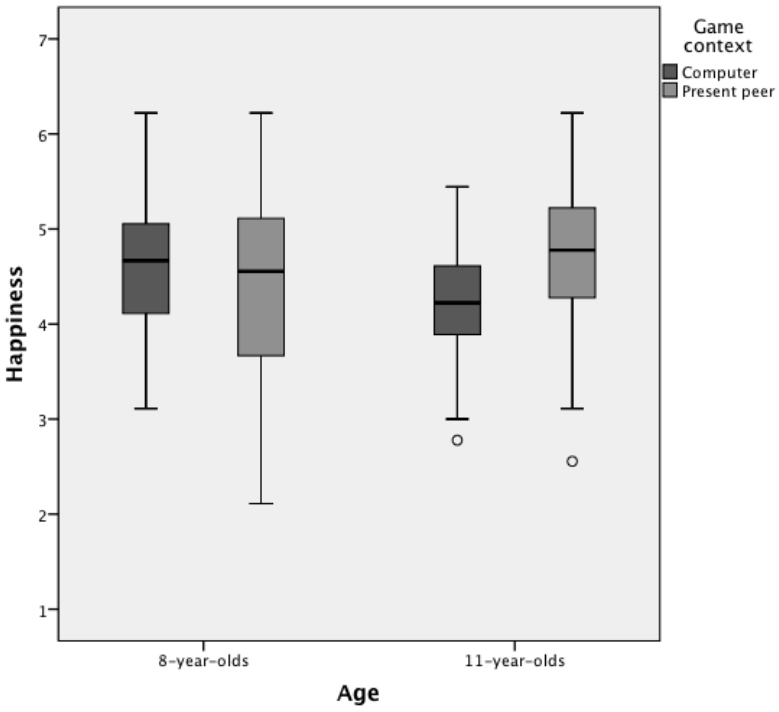

Figure 3.6. Perceived level of happiness as a function of game context and age.

Prize and game context also interacted on the perception of children's happiness, as shown in Figure 3.7. Split analyses showed that only when receiving the first prize, the physical presence of a peer affected children's expressions of happiness ($M_{computer}$ = 4.57, $SD_{computer}$ = 0.53; $M_{present\ peer}$ = 4.89, $SD_{present\ peer}$ = 0.60). When receiving the consolation prize, it did not matter if children were playing against the computer or against a peer, as they were rated as equally (un)happy ($M_{computer}$ = 4.27, $SD_{computer}$ = 0.52; $M_{present\ peer}$ = 4.17, $SD_{present\ peer}$ = 0.67).

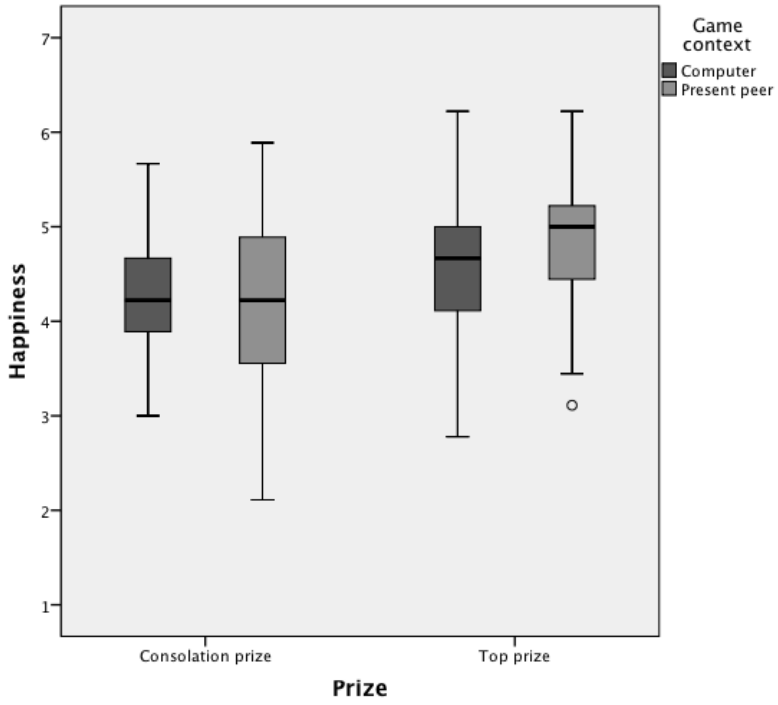

Figure 3.7. Perceived level of happiness as a function of game context and prize.

Finally, we found an interaction between prize, game context and age on perceived happiness. Table 3.2 shows that for 8-year-old children, physical presence of a contestant was not important when receiving the first prize; they appeared to be equally happy with it while playing against the computer. However, when 8-year-old children received the consolation price, they seemed to be happier when they played the game against the computer than when they played the game against a peer. In contrast, 11-year-old children who played the game in the "present peer" condition were perceived as happier with both the consolation prize as the first prize. When 11-year-olds played the game competing the computer, they were perceived to be relatively unhappy with both prizes.

All details of the ANOVA analysis can be found in Table 3.3.

Table 3.2. Perceived level of happiness in function of age, game context and prize.

Age	Game context	Prize	*M*	*SD*
8-year-olds	Computer	Consolation prize	4.34	0.55
		First prize	4.88	0.53
	Present peer	Consolation prize	3.74	0.86
		First prize	4.97	0.62
11-year-olds	Computer	Consolation prize	4.19	0.54
		First prize	4.27	0.57
	Present peer	Consolation prize	4.61	0.68
		First prize	4.81	0.66

Table 3.3. Overview ANOVA's with perceived level of happiness as independent variable for full fragments.

Factor(s)	*F*	*df*	*p*	*η2p*
Age	< 1	(1, 41)	ns	.00
Prize	159.83	(1, 41)	≤ .001	.80
Game context	7.11	(1, 41)	.01	.15
Age * Prize	106.29	(1, 41)	≤ .001	.72
Age * Game context	72.82	(1, 41)	≤ .001	.64
Prize * Game context	26.95	(1, 41)	≤ .001	.40
Age * Prize * Game context	15.13	(1, 41)	≤ .001	.27

Perception Experiment 2 – Split Fragments

Next, we tested the perception by third-party judges of children's happiness when receiving a prize in different fragments of the child's reactions. For this, we only used clips from the "present peer" condition, in which we focused on children's behavior before and after the moment of eye contact between contestants.

Method

Participants. In a second perception task, 42 adults (34 women, M = 21.02, SD = 2.23) judged a series of video fragments. Again, participants were students of Tilburg University who participated for partial course credit. None of the participants of the second perception task had participated in the first perception task.

Stimuli. For this second perception test, we selected all reactions of children who searched for eye contact with their opponent. These reactions were split in two phases; the first phase consisted of children's initial reaction to their gift before making eye contact with their opponent, the second phase contained their behavior after the moment of eye contact, when they were supposedly more aware of the presence (and gift) of their peer. This resulted in a total amount of 66 video clips, containing initial and secondary reactions of 33 children. All children came from the "present peer" condition, since in the "computer" condition there was no opponent for the participants to make eye contact with. For an overview of the distribution of experimental conditions in the stimuli used in the perception test, see Table 3.4. Similar to the first perception test, stimuli were presented without sounds.

Table 3.4. Selection of stimuli for split fragments perception test.

		Phase before eye contact	Phase after eye contact	Total for each condition
8-year-olds	Consolation prize	8	8	16
	First prize	8	8	16
11-year-olds	Consolation prize	6	6	12
	First prize	11	11	22
				Total of 66 stimuli

Procedure. Since the overall procedure for the second perception test was similar to the procedure of the first perception experiment, we refer to the corresponding section for a more detailed description.

Results

We analyzed children's expressions of happiness according to third-party judges by performing a repeated measures ANOVA with age (8- or 11-year-old), prize (consolation prize or first prize) and phase of children's reaction (before or after eye contact) as within-factors.

Similar to the results of the first perception test with complete fragments, we found that the type of the prize affected how third-party judges perceived children's level of happiness. Children who received the consolation prize were perceived as less happy ($M = 4.02$, $SD = 0.47$) than children who received the first prize ($M = 4.50$, $SD = 0.41$). Moreover, age did not have a main effect on the perceived level of happiness. Again, similar to results of the first perception test, there was an interaction effect of age and the nature of the prize children received on participants' perception of happiness, as shown in Figure 3.8. Split analyses showed that 8-years-old children were perceived to be happier with the first prize than with the consolation prize ($M_{\text{first prize}} = 4.58$, $SD_{\text{first prize}} = 0.45$; $M_{\text{consolation prize}} = 3.94$, $SD_{\text{consolation prize}} = 0.49$), whereas 11-year-old children seemed as happy with first prizes as with consolation prizes ($M_{\text{first prize}} = 4.41$, $SD_{\text{first prize}} = 0.43$; $M_{\text{consolation prize}} = 4.11$, $SD_{\text{consolation prize}} = 0.51$).

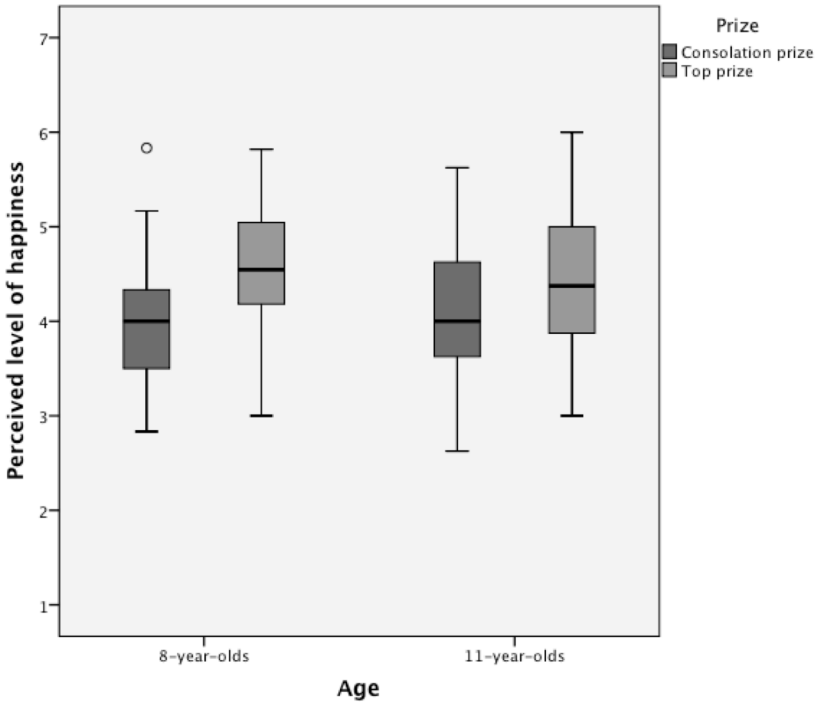

Figure 3.8. Perceived level of happiness as a function of prize and age (second perception test).

Since the aim of this second perception test was to focus on differences in initial an secondary phases of children's reactions, we were mainly interested in effects including the factor "phase". First, we found that in general, participants judged children to appear happier in the second phase, so after eye contact (M = 4.35, SD = 0.45), than in the initial phase, so before eye contact (M = 4.17, SD = 0.44). Moreover, children's age interacted with phase on the perception of their happiness, as displayed by Figure 3.9. Split analyses revealed that 8-year-old children appeared happier in the initial phase of their reaction than after they had eye contact with their peer (M_{inital} = 4.46, $SD_{initial}$ = 0.45; $M_{secondary}$ = 4.07, $SD_{secondary}$ = 0.49). However, for 11-year-old children, the opposite was the case; they were initially perceived as less happy, whereas they appeared happier after they had eye contact with their peer (M_{inital} = 3.88, SD_{inital} = 0.47; $M_{secondary}$ = 4.64, $SD_{secondary}$ = 0.49). There was no interaction between prize and phase. Regardless of eye contact, children were generally perceived happier being awarded the first prize than the consolation prize.

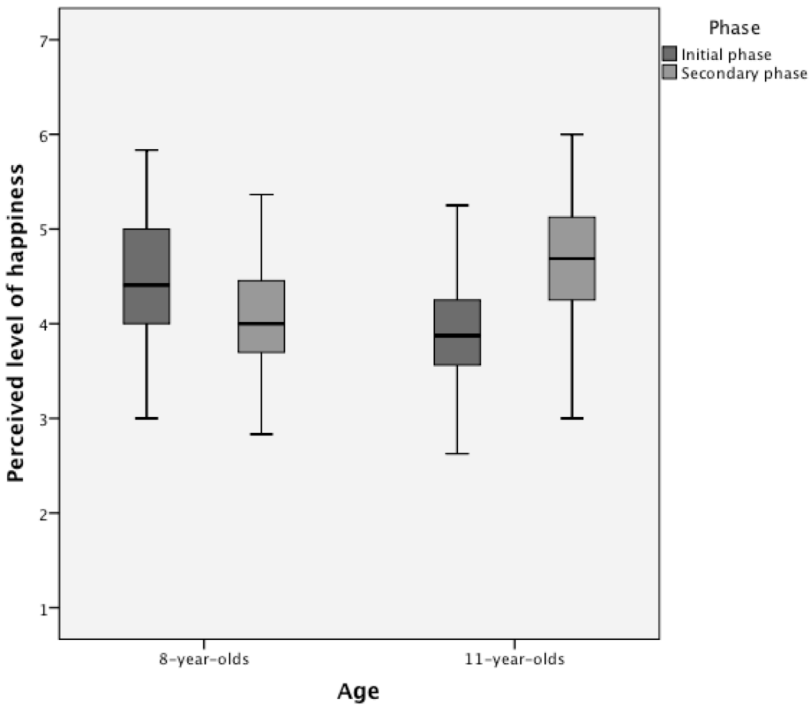

Figure 3.9. Perceived level of happiness as a function of phase and age.

Finally, we found an interaction between age, prize and phase on the perceived level of happiness. As shown in Table 3.5, 8-year-old children seemed to be less happy with their first prize as time passed. However, 11-year-old children were perceived to be happier in their reaction after they had eye contact with their opponent, compared to their reaction before they had eye contact, regardless of the type of prize.

Details of the statistical analyses are summarized in Table 3.6.

Table 3.5. Perceived level of happiness in function of age, prize and reaction.

Age	Prize	Phase	*M*	*SD*
8-year-olds	Consolation prize	Before eye contact	3.96	0.53
		After eye contact	3.91	0.60
	First prize	Before eye contact	4.95	0.47
		After eye contact	4.22	0.51
11-year-olds	Consolation prize	Before eye contact	3.85	0.50
		After eye contact	4.36	0.59
	First prize	Before eye contact	3.90	0.49
		After eye contact	4.91	0.49

Table 3.6. Overview ANOVA's with perceived level of happiness as independent variable for split fragments.

Factor(s)	*F*	*df*	*p*	*η2p*
Age	< 1	(1, 41)	ns	.00
Prize	158.40	(1, 41)	≤ .001	.79
Phase	21.52	(1, 41)	≤ .001	.34
Age * Prize	23.37	(1, 41)	≤ .001	.36
Age * Phase	249.30	(1, 41)	≤ .001	.86
Prize * Phase	1.71	(1, 41)	ns	.04
Age * Prize * Phase	60.08	(1, 41)	≤ .001	.59

General Discussion and Conclusion

When Jimmy Kimmel asked parents to give their offspring disappointing Christmas presents, this set-up led to interesting reactions of children, which appeared to be in line with what could be predicted based on recent emotional (appraisal) theories that suggest that a variety of social factors are likely to affect emotional expressive behavior (e.g., Fernández -Dols & Crivelli, 2013; Mumenthaler & Sander, 2012; Scherer & Ellgring, 2007). The current research systematically investigated how children's assessments of gifts, the co-presence of a peer and their age may impact their nonverbal expressions of emotion. To this end, we used a game-like behavioral experiment that would naturally elicit various emotional expressions. After playing a game, either by competing against a computer or a peer, that ended in a tie, we seemingly at random awarded 8- and 11-year-old children the first prize or the consolation prize. Before the game,

children typically reported to prefer the first prize to the consolation prize. Afterwards, they indicated to be happier when they had won the first prize, compared with being awarded the consolation prize. We analyzed children's accompanying expressions by presenting these to independent judges in two perception experiments, in which we asked them to rate their level of perceived happiness.

The first objective of this study was to examine how different contextual factors would affect children's emotional expressions. More specifically, we were interested in how the absence or co-presence of a peer would influence non-verbal emotional expressions in children when being confronted with a disappointing or satisfying event. When only focusing on the main effects, we found that, as expected, children awarded the first prize were perceived as happier than children awarded the consolation prize; similarly, results showed that children who played the game against a physically present contestant were perceived to be happier than children who were playing "alone" against the computer, regardless of the prize they won. Apparently, playing games with a physically present peer was perceived to be more enjoyable than when playing a game alone, which is in line with earlier research (e.g., Shahid et al., 2008). However, to examine how different social appraisals may affect our participants' emotional reactions, we were specifically interested in any interaction effect of co-presence and prize. Indeed, results showed that when receiving the first prize, children were happier when they were in the presence of a peer who received the consolation prize than when they were alone. On the other hand, when receiving the consolation prize, it did not matter if children were alone or in the presence of a peer, as they were rated as equally (un)happy. Regarding our first objective, we can conclude that children's emotional expressions were indeed affected by contextual factors, albeit only for satisfying events, like being awarded a first prize. However, all children, both those who were playing the game alone and those playing together with a peer, seemed equally disappointed when being awarded the consolation prize. This is in contrast with the results of de Waal and colleagues; they repeatedly found that primates' behavior was affected when receiving a disappointing reward, if their peer received a better alternative (Brosnan & de Waal, 2003: de Waal, 1997; de Waal & Davis, 2002). An explanation for this may be that these primates lacked certain social skills compared to children, and therefore were less influenced by the social setting than the child participants in our study.

The second objective of this study was to explore if the concept of age is meaningful in understanding children's expressive behavior in the co-presence of

a peer. As children grow older, they develop certain social skills that may be important for the occurrence of social appraisals for giving meaning to their emotions (Saarni, 1984; Saarni et al., 2006; Scherer, 2009). Indeed, when we compared the perceived level of happiness of 8- and 11-year-old children, we found effects of both prize and co-presence of peers. For 8-year-old children, the physical presence of a contestant was not important when receiving the first prize; they appeared to be equally happy with it. However, when they received the consolation price, they seemed to be happier when they played the game alone than when they played the game together with a peer. This is in line with outcomes of de Waal and colleagues studying capuchin monkeys (1997; 2002; 2003). In contrast, 11-year-old children who played the game with a peer were perceived as happier with both the consolation prize as the first prize than 11-year olds that played against the computer. When 11-year-olds played the game against the computer, they were perceived to be relatively unhappy with both prizes. These findings supported the view that children gradually learn to adjust their expressive behavior, depending on their social environment. This is in line with studies that used the mistaken gift paradigm, which have shown that age affected children's reactions while receiving disappointing presents, in a sense that older children showed less disappointment than younger children (Cole, 1986; Garner & Power, 1986; Kieras et al., 2005). We can conclude that as children grow older, social appraisals get more important and they would show more happiness when receiving a seemingly more disappointing present. So, this study not only provides evidence for an effect of social appraisals when receiving disappointing or satisfying events, but the way children respond emotionally seems to be affected by developmental factors as well.

Finally, we studied how changes in children's assessments of the social contact, also known as re-appraisals, may affect their expressive behavior in the course of their response. Emotion processes are non-static and dynamically adjusted over time, and have been argued to vary as a function of alternating social appraisals (Scherer, 2009). Hence, in the second perception experiment, participants' expressions were analyzed not only right after they were presented with either the first prize or consolation prize, but also after they had their first post-gift eye contact with their co-present peer. First, we found a main effect of phase. In general, children were perceived happier after eye contact than before. However, looking at the interaction with age suggests a more nuanced picture. Our findings showed different expressive behavior for both age groups, indicating that eye contact affected the expressive behavior of 8-year-old children in a negative way and that of 11-year-old children in a positive way. The latter

seemed happier after they had eye contact with their peer, compared to their initial expression. Similar results were found in a three-way interaction of age, prize and phase. For 11-year-old children, we found no effect of prize and phase for their expressions of happiness, in contrast with 8-year-old children. This again indicated that as children grow older and develop their social skills, their social awareness increases and they adjust their expressive behavior by smiling in the presence of a peer regardless of whether they appreciate their prize or not.

Overall, this research contributes to the idea that emotional expressions are by no means isolated concepts, but are constructed by the evaluation of a (social) context (i.e. social appraisals). Additionally, we have shown that as children's social awareness increases, their expressions are affected by social appraisals, which may alternate during the course of their response.

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4

Children's expression of uncertainty in collaborative and competitive contexts

Abstract

This chapter investigates the effect of two social settings (collaborative versus competitive) on the audiovisual expression of uncertainty by children in two age groups (8 and 11). We conducted an experiment in which children played a quiz game in pairs. They either had to collaborate or compete with each other. We found that the Feeling-of-Knowing of 8-year-old children did not seem to be affected by the social setting, contrary to the Feeling-of-Knowing of 11-year-old children. Additionally, we labeled children's expressions in clips taken from the experiment for various visual and auditory features. We found that children used some of these features to signal uncertainty and that older children exhibited clearer cues than younger children. In a subsequent perception test, adults rated children's certainty in clips used for labeling. It appeared that older children and children in competition expressed their confidence level more clearly than younger children and children in collaboration.

This chapter is adapted from;

Visser, M., Kramer, E. J., & Swerts, M. (2014). Children's expression of uncertainty in collaborative and competitive contexts. *Language and Speech, 57,* 86-107.

Introduction

Answering questions is a task people perform daily. Sometimes these questions are easy, sometimes they are more difficult to answer. For example, when a typical 11-year-old European boy is asked which television show he prefers, he would probably find that question much easier to answer than a question like: "What is the capital city of Mozambique?", a country he may never have visited. Accordingly, producing such answers is often accompanied by a feeling of relative certainty or uncertainty. It is generally assumed that speakers can signal their (un)certainty about the correctness of an answer with a variety of auditory and visual cues, and that others can interpret these cues correctly. This study aims to explore the expression of (un)certainty, specifically focusing on the potential effect of both contextual and developmental factors, something which has been lacking in earlier studies. We first focus on some relevant theories and previous research in the expression of (un)certainty.

Several researchers have looked into the expression of (un)certainty, using the Feeling-of-Knowing paradigm (Brennan & Williams, 1995; Hart, 1965; Krahmer & Swerts, 2005; Smith & Clark, 1993; Swerts & Krahmer, 2005). In this paradigm, pioneered by Hart (1965), participants are asked to try and respond to sequences of questions about different topics. After this quiz-like test, participants are again presented with the same set of questions, but instead of having to answer them, participants are asked to indicate how sure they are that they could recognize the correct answer in a multiple choice test. This particular rating of certainty is referred to as the Feeling-of-Knowing (FOK) score. Analyses revealed that this self-rated FOK correlates with the correctness of the answer (e.g., Hart, 1965) and the presence or absence of auditory and visual features (Corley & Stewart, 2008; Kimble & Seidel, 1991; Krahmer & Swerts, 2005; Pon-Barry & Shieber, 2011; Smith & Clark, 1993; Stone & Oh, 2008; Swerts & Krahmer, 2005; Wollermann & Lasarcyk, 2007; Wollermann & Schröder, 2009). It appears that when people are uncertain about their answer, they are more expressive than when they are certain. For example, uncertain people tend to use more auditory cues, like linguistic hedges such as "I guess" or "perhaps" (Smith & Clark, 1993), or fillers, like "uhm" (Corley & Stewart, 2008), and they tend to raise their pitch more (Wollermann & Lasarcyk, 2007; Wollermann & Schröder, 2009). Additionally, uncertain people are likely to use more visual cues, such as eye or brow movements (Swerts & Krahmer, 2005).

The use of auditory and visual cues for signaling uncertainty suggests that question answering involves two components. People do not only search in their

memory for an answer, they also monitor this search on a meta-cognitive level (Koriat, 1993; Nelson, 1993; Nelson & Narens, 1990). It has been suggested that expressing uncertainty is a social process, which involves information exchange as well as self-presentation to the questioner (Smith & Clark, 1993; Swerts & Krahmer, 2005). For the purpose of self-presentation, people tend to have specific strategies to protect themselves (Gnepp & Hess, 1986). In particular, when a person answers a question with a relatively low confidence level, the person can show this uncertainty in his or her response, using the auditory and visual features described earlier. If the answer would turn out to be incorrect later on, the speaker might save face and look less unintelligent, since it was already suggested that there was little confidence in the response (Swerts & Krahmer, 2005).

This tendency to express one's confidence level is in line with what has been claimed regarding so-called display rules. These are principles that help individuals manage and modify their emotional expressions, depending on social circumstances, and mainly have two functions (Ekman & Friesen, 1975). First, when display rules are used as social conventions, they can serve a cultural, pro-social purpose (for example, shaking hands is appropriate is some countries, in others it is not). Second, display rules can function as self-protective, like in the case of saving face when showing uncertainty. Self-protective display rules are based on an individual's expectations of the consequences of expressing a particular feeling in a given situation (Ekman & Friesen, 1975; Gnepp & Hess, 1986; Saarni, 1981). There are multiple ways in which display rules can operate in order to manage expressions, for example, exaggerating or minimizing expressions of emotions, but also neutralizing or faking them (Matsumoto, Hee Yoo, Hirayama & Petrova, 2005). In this way, people can regulate their social interaction (DePaulo, 1992; Ekman & Oster, 1979; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006). Communicative behavior can be adjusted by recognizing and anticipating specific auditory or visual cues, like moving eyebrows or ending a sentence with a high pitched voice when answering a question probably implies uncertainty.

While most studies so far focused on the expression of (un)certainty in adults, to our knowledge only one study explored the expression of (un)certainty of children (Krahmer & Swerts, 2005). Children have been argued to be less able to reason meta-cognitively about such intentional states as beliefs and knowledge, both in their own mind and that of others (Piaget, 1950), so that it might seem unlikely that young children would be able to judge their own FOK. Various studies showed that children start to judge their FOK in an accurate way when

answering questions around the age of 6 (Butterfield, Nelson & Peck, 1988; Lockl & Schneider, 2002). Hence, Krahmer and Swerts (2005) compared the production of (un)certainty in audiovisual speech for adults and children (around 7 years old). It appeared that children's capabilities for judging their certainty, by indicating a FOK score, were indeed as accurate as what had been observed in studies with adults. Yet, it seems that children have a different way of expressing their degree of certainty. Krahmer and Swerts (2005) revealed that when child speakers indicated that they were uncertain about their answer, they were less likely to use auditory and visual cues than adults indicating a low FOK score. Moreover, children's expressions of uncertainty were less well recognized by independent observers than adults'.

Thus, it seems that children in the age group around 7 express their uncertainty to a lesser degree than adults. This could be due to the function of expressing (un)certainty as a self-protective display rule, by regulating social interaction. Arguably, children in the age group that Krahmer and Swerts (2005) studied are not fully acquainted yet with specific display rules (Piaget, 1950; Saarni, 1984). Children are only starting to recognize and use display rules around the age of 8, and by the age of 11, they are still in the middle of learning this (Saarni, 1984). Most probably, children's use of audiovisual cues develops as a function of this increasing knowledge of display rules, and children gradually learn how to adjust their nonverbal behavior to certain social situations (Gnepp & Hess, 1986; Saarni, 1984).

Indeed, in line with what we know about their general cognitive and linguistic development, there are reasons to assume that children's use of nonverbal behavior changes as they grow older, as does the relative importance of nonverbal features for communicative purposes. Given that their verbal capabilities are still limited, infants make extensive use of nonverbal cues to communicate. For example, when a 6-months-old baby is hungry, his or her attempt to inform someone about this will involve nonverbal behavior like crying. As children grow older and their verbal skills improve, they tend to use less nonverbal cues for the exchange of this kind of information (Knapp & Hall, 2010). On the other hand, older children get comparatively better in using nonverbal features for other social purposes. Children's social awareness and knowledge of display rules increases and as a result, children learn what type of nonverbal behavior is considered to be appropriate or rather effective in specific social contexts (Ekman & Oster, 1979; Gnepp & Hess, 1986; Saarni, 1979). For instance, when receiving a present that a child does not like, he or she would probably

smile and look thankful, although he or she might feel differently, merely for being polite (Kieras, Tobin, Graziano & Rothbart, 2005).

In other words, as children grow older, their use of nonverbal behavior becomes more strategic. Therefore, age might be an important factor when studying children's expressions of uncertainty. Krahmer and Swerts (2005) did find a difference in expressing (un)certainty between 7-year-old children and adults. However, they did not take the development of nonverbal behavior into account by comparing children in different age groups. Therefore, the first aim of this research is to study children's expression of (un)certainty in two age groups, namely 8-year-old children and 11-year-old children. Saarni (1981) showed that children's knowledge of display rules doubles between the age of 8 and 11. Apparently, 8-year-old children apply display rules in about 25 per cent of social situations that require the use of these social conventions. Additionally, 11-year-old children seem to use display rules in 50 per cent of social situations. Thus, on account of the enduring development of social awareness and knowledge of display rules, older children use probably more auditory and visual cues when expressing uncertainty than younger children.

So the results from Saarni (1981) suggests that as children grow older, they will get better in adapting their nonverbal behavior to specific social contexts, including the expression of uncertainty. However, previous research on children's nonverbal behavior has rarely considered such social contexts (e.g., Agaliotis & Kalyva, 2008; Reisenzein, Bördgen, Holtbernd & Matz, 2006). Some researchers took social presence into account while studying audiovisual speech (e.g., Kimble & Seidel, 1991; Shahid, Krahmer & Swerts, 2008; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006) and social perspective has been acknowledged as an important factor for learning language specific rules for facial expressions (Swerts, 2011). However, these previous studies have only looked at what happens when comparing social versus non-social settings, while it is intuitively clear that the *type* of social setting may matter as well. Studies considering different social situations with accompanying display rules are lacking. Nonetheless, it is likely that various social settings may have different impacts on children's expressive behavior. Different social settings may have different goal structures and interests (e.g., Brady, Newcomb & Hartup, 1983; Deutsch, 1949; Johnson & Johnson, 1974; Kelley & Thibaut, 1969; Madsen & Shapira, 1970; Richmond & Weiner, 1978; Roseth, Johnson & Johnson, 2008) and in this way may possibly trigger different uses of self-protective display rules and accompanying nonverbal behavior. Therefore, we believe that several social settings should be considered, when studying children's expressions of (un)certainty.

Therefore, the second aim of this study is to take different social settings that are associated with different display rules into account, when examining children's expression of (un)certainty. To evoke children's feelings of (un)certainty, we created a quiz game that could be played in two conditions, namely a collaborative or competitive setting. We expect that there are different types of behavior in collaborative and competitive settings, depending on whether the actions of the individuals involved are seen as increasing or decreasing the chances of goal attainment (Johnson & Johnson, 1974). Following Deutsch (1949), we define a collaborative setting as one where the goals of the separate individuals are linked together to such an extent that there is a positive correlation between their goal attainments. Under collaborative conditions, individuals can only achieve their goal if the other persons with whom they are linked can also achieve their goal. Therefore, an outcome will be sought that is beneficial for all participants. However, in a competitive setting, persons can only achieve their goal if the others with whom they are linked cannot achieve their goal (Deutsch, 1949). Individuals are rewarded in such a way that if one receives a maximum reward, the other receives a minimum reward (Kelley & Thibaut, 1969). Consequently, when collaboration and competition are taken into account for examining the expression of (un)certainty, different display rules may be used and therefore it is likely that auditory and visual cues may differ as well. For example, in a competitive setting, saving face might be more important than in a collaborative setting, as this may impress the opponent and increase one's chance of winning. Therefore, participants might use auditory and visual cues for expressing (un)certainty. In a collaborative setting, participants aim for a shared goal. As a result, it is likely that they care less about self-protective display rules such as saving face and are more concerned about suiting the other person.

In this study we want to investigate the influence of a collaborative setting and a competitive setting on auditory and visual signaling of uncertainty of children with the age of 8 or 11. Due to the substantial increase of the knowledge of display rules between the ages 8 and 11 (Saarni, 1981), we expect the social setting to be of more influence for expressing uncertainty in a nonverbal manner for 11-year-old children than for 8-year-old children. We conducted three studies. The aim of the first study was to examine whether there was an actual difference of children's production of FOK in different age groups and social settings. In our second study we wanted to know which auditory and visual features were used for signaling (un)certainty. In our third study, we focused on the perception (by independent adult judges) of the auditory and visual cues children used for showing their (un)certainty.

Study 1: Production of Uncertainty

In our first study, we focused on the production of (un)certainty in two social settings (collaborative and competitive) and two age groups (8 and 11 years old). We used an adaptation of the methodology of Krahmer and Swerts (2005). Instead of simply asking the factual questions to one participant at a time, we created an experiment in which two participants simultaneously played a knowledge quiz. Game-based experiments like this are found to be suitable for eliciting children's expressions or emotions in a natural and ethical way (Shahid et al., 2008). We hypothesized that the social setting has little or no effect on the FOK of the participants in the youngest age group. We did expect a comparatively large difference between the collaboration and competition condition in the age group of 11, due to their social development (Piaget, 1950). Older children are presumably more aware of the social setting than younger children, which might affect their FOK.

Method

Participants. In total, 90 children participated in the experiment. We selected participants in two age groups, namely 8-year-old children (42 children in total, 45% girls) and 11-year-old children (48 children in total, 56% girls). They played the quiz game in self selected pairs. We divided these pairs randomly across two experimental settings; a collaborative setting and a competitive setting. The experiment was conducted in two primary schools in Zoetermeer, the Netherlands. Parents of the children were informed about the experiment and asked for approval for participation beforehand. Children had to hand in a signed consent form before they could participate in the quiz game.

Stimuli. For collecting children's certain and uncertain answers, we used a quiz game inspired by Hart (1965). The quiz consisted of 30 questions, which the pairs were asked to answer taking turns, such that each participant responded to half of the questions. These questions were partly adapted from earlier research by Krahmer and Swerts (2005). They selected their questions from a Dutch version of the "Wechsler Intelligence Scale for Children" (WISC) and the children's edition of the game Trivial Pursuit. Following earlier studies using this paradigm, we selected questions that allowed for a single word answer; this makes it easy to determine whether an answer is correct or not and to compare answers of different participants. In addition, we ensured that both easy and hard questions were included, in order to elicit responses that were either certain or uncertain. Even when the question's perceived level of difficulty might vary between

children, our attempt was to include a sufficient number of questions that were likely to be easy or difficult for children. In doing so, we made sure that the majority of the questions was expected to be easy for children, in order to avoid that a large proportion of difficult questions would frustrate them. An example of an easy question is "Which animals live in an aquarium?" and an example of a difficult question is "Who discovered America?" We pre-tested the questions with one pair of children for each condition (4 pairs in total), and it appeared that by asking the selected questions, we could evoke various levels of certainty in children of both 8 and 11 years old. Therefore, we used all 30 questions in both our age groups (for the complete set of questions, see the Appendix).

Experimental procedure. Before the experiment, pairs of participants were randomly assigned to a competitive or collaborative condition. Instructions have been shown to highly affect the extent to which children behave in a competitive or collaborative way (Madsen & Shapira, 1970). Therefore, the children were given a clear and extensive instruction by the experimenter and were explicitly told that they were to answer as many questions correct as possible together (collaborative setting), or they were explicitly told that they were playing against each other, and that they had to compete to get the greatest number of correct answers (competitive setting). To emphasize this social setting, participants wore T-shirts in the same color in the collaborative setting, and different-colored T-shirts in the competitive setting. Apart from the instruction given by the experimenter and the color of the T-shirts, the experimental procedure was exactly the same for both conditions.

After having been assigned to one of the conditions, we told the participants that the level of difficulty of the questions varied and that they were not expected to be able to answer all questions correctly. Both participants were placed in front of a different computer screen, on which questions were displayed. Participants had to take turns answering. It was always clearly indicated on the screen who was to answer the current question; questions were always displayed on both screens. There was no time limit on answers, so the pace of the experiments was determined by the participants. Their responses were filmed using video cameras, recording their face and upper body. Participants were able to hear each other's answers, but they could not see each other. In this way, they would not interfere the experiment's procedure (see Figure 4.1 and Figure 4.2).

After answering a question, participants were instructed to indicate how certain they were about the correctness of their answer. They had to indicate their certainty on a five-point Likert scale, using individual facial representations

of the items (see Figure 4.3). For example, a very sad face (mouth corners pulled down) represented a score of 0 (very uncertain), and a happy face (mouth corners pulled up) represented a score of 4 (very certain). These facial representations of Likert scales are relatively standard for studies involving children (e.g., Lockl & Schneider, 2002). The participants were instructed to select the face that best represented their feeling of certainty and to show it to the camera. Children reported that it was easy to use these facial representations.

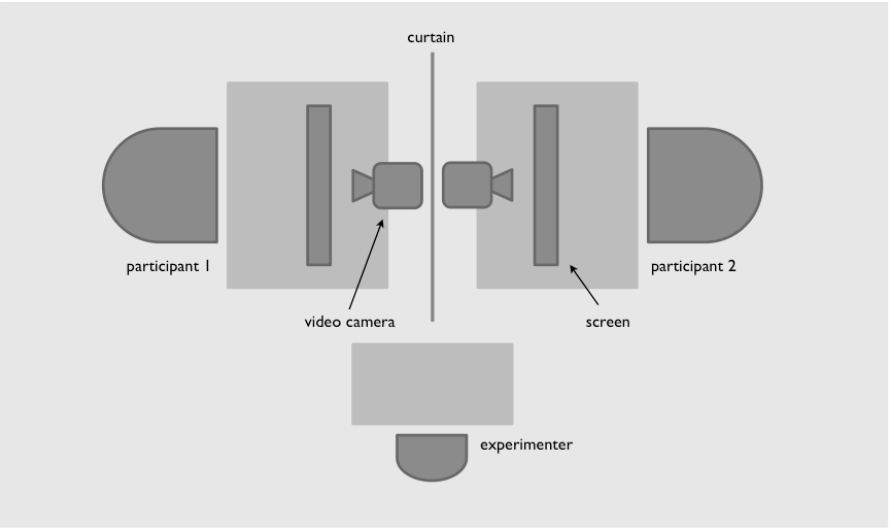

Figure 4.1. Experimental setting.

Figure 4.2. Picture experimental setting.

All the pairs of participants started the experiment with a training part to ensure they were familiar with the quiz and the social setting they were in. This training phase consisted of ten questions with different levels of difficulty (five for each participant). During this phase, the experimenter stressed the importance of trying to give a correct answer. To stimulate participants to try their best and to emphasize the social setting pairs were in (competition or collaboration), they were told that (depending on the condition) the best individual or the best team of the class would receive a prize. According to several studies, a prospect of a group or individual reward is important for emphasizing social settings (Madsen & Shapira, 1970; Richmond & Weiner, 1978). When a task involves a group reward, collaboration is relatively high. But when children are tested under individual reward conditions, competition becomes predominant, even if it prevents any child from receiving a reward. In addition, after participating in the experiment, all participants received a small reward (pencil and eraser).

Figure 4.3. Participant indicating his Feeling-of-Knowing.

Results

A total amount of 1350 answers were produced by the participants during the experiment. However, 22 answers of participants were not accompanied by a clear FOK indication (for example, participants forgot to indicate their FOK after giving an answer, or their indication was not clear in the video). These utterances were excluded from the study. Finally, 1328 produced FOK utterances were used. As Figure 4.4 shows, we obtained all possible scores, from zero to four on a five-point Likert scale. But as intended, the majority of the FOK scores were of level 4, in line with our attempt to make most of the questions easy to answer. Note, though, that we still retrieved a sufficiently large number of low FOK scores to be used in follow-up experiments and measurements (see below).

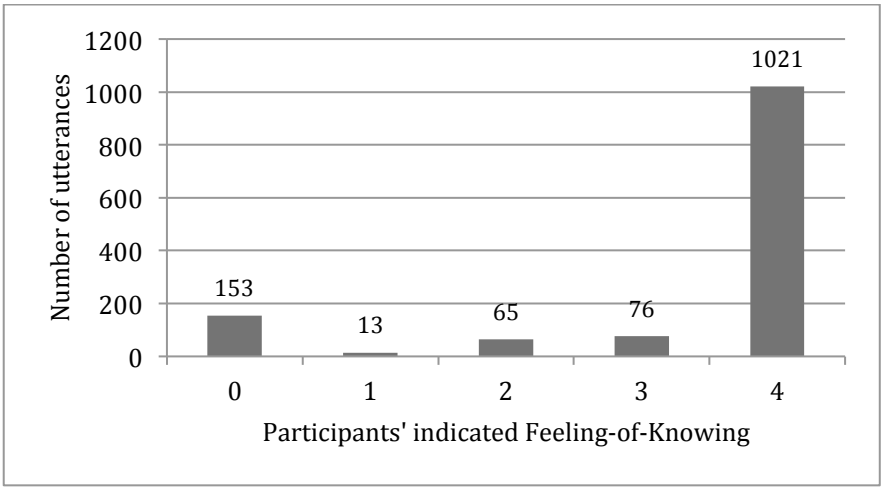

Figure 4.4. Distribution of indicated Feeling-of-Knowing (FOK) scores (N = 1328).

We conducted a 2 x 2 ANOVA with factors age and social setting, and children's FOK as our dependent variable. There appeared to be no main effect of age, $F(1,89) = .686$, *ns*. We also did not find a main effect of social setting, $F(1,89) = 2.008$, *ns*. However, there was a significant interaction effect between age and social setting, $F(1,89) = 4.101$, $p < .05$, $\eta^2_p = .05$. Split analyses show that the average FOK score is not affected by whether 8-year-old children are in the collaboration condition or in the competition condition (Collaboration: $M = 3.51$, $SD = .51$; Competition: $M = 3.44$, $SD = .51$), $F(1,41) = 0.184$, *ns*. Yet, as we hypothesized, the social setting does affect the average FOK scores of 11-year-old children. The mean FOK ratings of this age group were higher for competition play ($M = 3.57$, $SD = .42$) than for team play ($M = 3.19$, $SD = .65$), $F(1,47) = 4.736$, $p < .05$, $\eta^2_p = .09$.

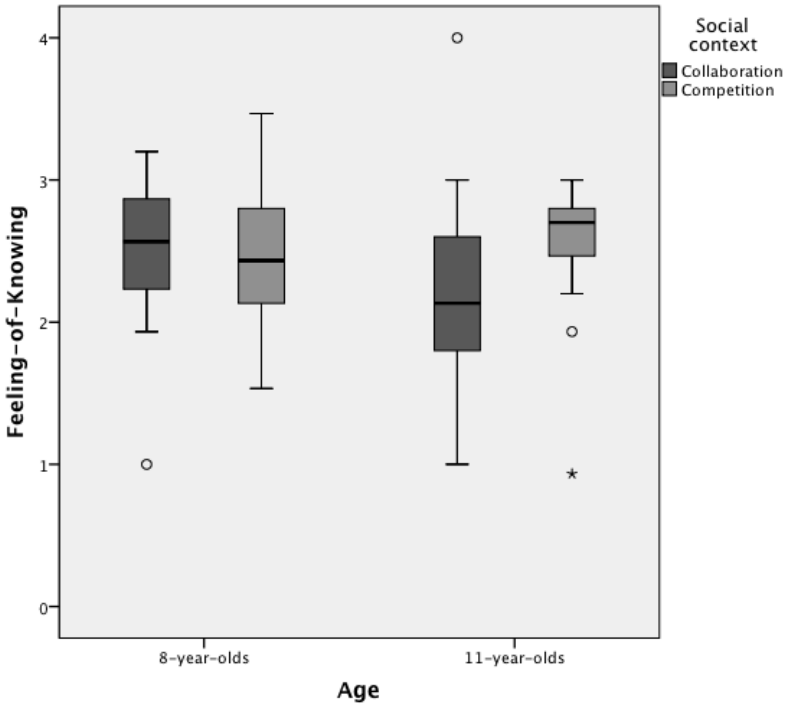

Figure 4.5. Feeling-of-Knowing (FOK) scores as a function of social setting and age.

Discussion

In our first study we wanted to evoke feelings of (un)certainty in 8- and 11-year-old children in both collaborative and competitive settings. We hypothesized that the social setting would only affect the indication of certainty of 11-year-old children. This was confirmed by the data. Although there were no main effects for both age and social setting on participants' FOK, we did find an interaction between age and social setting on the FOK of participants (see Figure 4.5). For 8-year-old children, the social setting had no significant effect on FOK. However, 11-year-old children scored their FOK significantly higher in competition play than in collaboration play. This could be explained by the further developed social consciousness of 11-year-old children. According to Piaget (1950), children in that age group are more socially developed than 8-year-old children. Therefore, they should be more aware of the social setting that they are in.

It appeared that 11-year-old children felt less certain in collaboration than in competition. A reason for this might be that the different social settings require

different goal attainments (Deutsch, 1949). In competition, the battle with an opponent might be more salient for participants than when they are in collaboration. 11-year-old children in a competitive setting might be more inclined to give a higher estimate of their FOK in an attempt to consciously or unconsciously improve their confidence, thereby suggesting to their opponent that they are doing well. As a result, they might feel more certain about their answers than collaborating participants, who share a goal and the accompanying responsibility for their success.

Study 2: Expression of Uncertainty

In our first study, we compared self-rated feelings of uncertainty of children in different age groups and social settings. In our second study, we wanted to analyze the expression of this self-rated feeling of uncertainty, by labeling a selection of utterances, filmed during the first study. We expected children in our oldest age group to be more aware of display rules, and therefore express their uncertainty in a different, clearer way than children in our youngest age group. Moreover, children of 11 might be more aware of the social setting, and therefore we expected an effect of the social setting on the use of auditory and visual cues for expressing (un)certainty in this age group.

Method

Stimuli. From the corpus of answers collected in the first study, we selected 64 clips of children answering a question during the quiz game, with an equal distribution of high (maximum score of 4 on a 5 point Likert scale) and low (minimum score of 0 on a 5 point Likert scale) self-indicated FOK scores, with an equal distribution across age and social settings. This gave a 2 x 2 x 2 design (FOK x age group x social setting), see Table 4.1. The original selection of stimuli that followed was random, but utterances were iteratively replaced until a number of criteria were met. First, the answers given in the selected clip had to be lexically different from each other to avoid that coders would have to label clips with similar content. Second, the speaker should appear in labeled clips twice, with both a low and a high FOK answer. Third, no non-answers were taken into account, non-answers being defined as variants of "I don't know" responses. Note also that the selected clips only contained the actual response from the child, so without the question that preceded their answer. In this way, 64 video fragments were randomly selected. After the selection, all FOK scores presented on the

smileys in the clips (see Figure 4.2) were blurred, so no indication of the FOK score was shown in the fragments, to prevent that labelers could base their coding on them.

Table 4.1. Selection of stimuli for labeling expressions.

	Collaboration		Competition	
	8-year-olds	11-year-olds	8-year-olds	11-year-olds
Low FOK	8	8	8	8
High FOK	8	8	8	8

Labeling and annotation. All selected clips of participating children were manually labeled by two coders independently. According to an explicit labeling protocol, they annotated the presence or absence of the following auditory and visual features:

- Filler: whether the participant used fillers (words and non-words, like "uhm") or not.
- Delay: whether the participant took some time to respond or responded immediately after reading the question.
- High intonation: whether the participant ended his or her answer in a high boundary tone or not.
- Eyebrow movement: whether the participant moved one or both eyebrows during the response or not.
- Smile: whether the participant smiled (moving corners of the lips) during the response or not.
- Funny or thinking face: whether the participant produced a "marked facial expression" during the response or not.

We chose these features based on earlier reports that showed their potential relevance for the signaling of (un)certainty (Krahmer & Swerts, 2005; Swerts & Krahmer, 2005). Our visual labels were roughly based on earlier research by Ekman and Friesen (1978). They formulated a coding system by examining single muscular actions of facial expressions. According to their Facial Action Coding System, these muscular actions are the fundaments of more complex facial expressions. The three auditory labels were used in earlier research according to

the FOK paradigm (Brennan & Williams, 1995; Smith & Clark, 1993; Swerts & Krahmer, 2005). See Figures 4.6 for representative examples of the labeled visual cues. To avoid circularity, coders were blind to the participant's score of FOK and the social situation during the labeling. Features were only labeled as being present when this was clearly the case. Before the actual labeling, the coders labeled several clips together for practice. All Kappa's indicated acceptable inter coder agreement (Kappa's were .65 for fillers, .67 for delays, .63 for high intonations, .68 for brow movements, .74 for smiles and .65 for funny faces). Inconsistent labels were discussed until consensus was reached.

Figure 4.6. Stills illustrating the three labeled visual features (left: eyebrow movement; middle: smile; right: funny face).

Results

We used analysis of variance (ANOVA) with low and high FOK, age and social setting as factors. Our dependent variables were the percentages of present labeled auditory and visual features. To compensate for departures from normality, we applied a standard arcsin transformation to the proportions before running the ANOVA (Field, 2009). For presentational purposes however, we report proportions of used features in Table 4.2.

There appeared to be an overall effect of FOK on the use of features, $F(1,63) = 28.67$, $p < .001$, $\eta^2_p = .34$. When participants indicated a low FOK, they generally used more features than when they indicated a high FOK. In addition, we analysed all the labelled features separately. Table 4.2 shows that low FOK answers were more likely to be produced with a longer delay, with high intonation, with eyebrow movements and with a funny face, compared to high FOK answers. However, there appeared to be no effect of age, $F(1,63) = .407$, *ns,* or social setting, $F(1,63) = .824$, *ns*, on signaling features.

Table 4.2. The average proportion of low (l) and high Feeling-of-Knowing (FOK) utterances (N = 32) in which a specific feature is present.

FOK	Filler		Delay*		High intonation*		Eyebrow*		Smile		Funny Face*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Low	.47	.51	.91	.30	.84	.37	.69	.47	.63	.49	.47	.51
High	.13	.34	.31	.47	.44	.55	.25	.44	.59	.50	.13	.34

** $p < .01$*

Discussion

To obtain a better insight into the actual features that children used to express feelings of (un)certainty, 64 video clips were labeled in terms of three auditory and three visual features. It appeared that there was a significant difference in the use of features between low and high FOK answers, in line with earlier research (Krahmer & Swerts, 2005). When children in both age groups and social settings were uncertain, they used delays, funny faces, eyebrow movement and high intonation more frequently than when they were certain while answering a question. Overall, children thus seem to use nonverbal cues for expressing uncertainty as a way of self-presentation.

Furthermore, against our expectations, we found no effect of age groups or social setting. For expressing (un)certainty, it did not matter in which social setting or age group participants were. However, it is conceivable that these factors are nevertheless important for expressing (un)certainty, although this was not revealed by distributional patterns in the labeled features. After all, perception of (un)certainty is important for the function of self-presentation and might involve more or subtler features than those that were labeled. It would be interesting to see if expressions of either certainty or uncertainty are perceived in the same way for both age groups and social settings. Therefore, we decided to conduct a third study.

Study 3: Perception of Uncertainty

In the first and second study, we focused on the feeling of (un)certainty and its auditory and visual expression. It appeared that there was an interaction effect of age and social setting on feelings of (un)certainty. However, children appeared not to use the features as labeled in the second study, for expressing this

uncertainty. In our third study, we are interested whether self-reported feelings of (un)certainty are perceived by other people, a concept that is referred to as the Feeling-of-Another's-Knowing (FOAK). Earlier research showed that people are capable of adequately estimating someone's certainty based on their signaling of auditory and visual cues (Brennan & Williams, 1995; Jameson, Nelson, Leonesio & Narens, 1993). Krahmer and Swerts (2005) revealed that children's auditory and visual cues have communicative relevance, since participants in a perception test could estimate the (un)certainty of children's answers, although to a lesser extent than they could do this for adults. We think it would be interesting to see how children's expression of uncertainty in different age groups and social settings would be perceived.

The third study consisted of a rating experiment that tested how stimuli from the production experiment are perceived in terms of (un)certainty as a function of social setting and age groups. In the perception test, we used the same data as in the second study as stimuli. Again, we expected 11-year-old children to act more in accordance with accompanied display rules, and therefore their confidence level is probably to be more correctly perceived than that of 8-year-old children. Moreover, as shown in our first study, 11-year-old children might be more aware of the social setting, and therefore we expect an effect of the social setting on the perception of (un)certainty in that age group.

Method

Participants. 38 adults participated as judges in a perception experiment. These adults were all students from Tilburg University and were between 18 and 27 years old (58% female).

Stimuli: We used the same dataset as in the second study, which contained 64 clips of children answering a question during the quiz game. The dataset was equally distributed between low and high FOK answers, in both age groups and social settings. For an exact description of the semi-random stimuli selection procedure, see study 2 and Table 4.1.

Procedure: All 64 stimuli were shown to the participants in two random orders. First, the identification number of the stimulus was presented (1 through 64), followed by the actual stimulus. During an inter-stimulus interval of three seconds the screen turned black, and participants were asked to rate the speaker's certainty, FOAK, on a five-point Likert scale. To ensure that participants were familiar with the perception task, the experiment was preceded by a training phase containing 4 stimuli. Participants completed the perception task in

a room with the experimenter and one other participant, seated in such a way that they could not see each other.

Results

We conducted a repeated measures ANOVA with FOK, age and social setting as factors and the participants' FOAK scores as our dependent variable. As expected, there was a main effect of the FOK score on the FOAK score in the perception experiment, $F(1,37) = 1501.176$, $p < .001$, $\eta^2_p = .98$. The FOAK scores closely matched the original FOK scores in that the responses with a high FOK were indeed rated as having a significantly higher FOAK than responses with a low FOK. Moreover, we found main effects of both age and social setting on FOAK as well. It appeared that 8-year-old children were perceived as more uncertain than 11-year-old children (8-year-old children: $M = 2.03$, $SD = .31$; 11-year-old children: $M = 2.14$, $SD = .22$), $F(1,37) = 10.487$, $p < .01$, $\eta^2_p = .22$. Further, competing children were perceived as more uncertain than children who were collaborating (competing children: $M = 2.03$, $SD = .28$; collaborating children: $M = 2.14$, $SD = .27$), $F(1,34) = 8.055$, $p < .01$, $\eta^2_p = .18$.

However, when we made a distinction between stimuli that contained low or high FOK utterances, we also found several interaction effects. A significant two-way interaction was found between age and FOK score on participants' FOAK, $F(1,37) = 161{,}792$, $p < .001$, $\eta^2_p = .81$. As Figure 4.7 shows, it appeared that for 8-year-old children, the difference between low and high FOK was smaller than for 11-year-old children. Children of 11 seem to be more expressive in showing both their uncertainty and certainty than children of 8. A similar effect is found in the difference between collaboration and competition condition on participants' FOAK, $F(1,37) = 37.541$, $p < .001$, $\eta^2_p = .50$. Figure 4.8 shows that although high FOK answers are rated nearly the same in both social settings, for collaborating children the difference in judged expression of low FOK was smaller than for competing children. In the collaboration condition, children seemed less expressive about being uncertain or certain than in the competition condition.

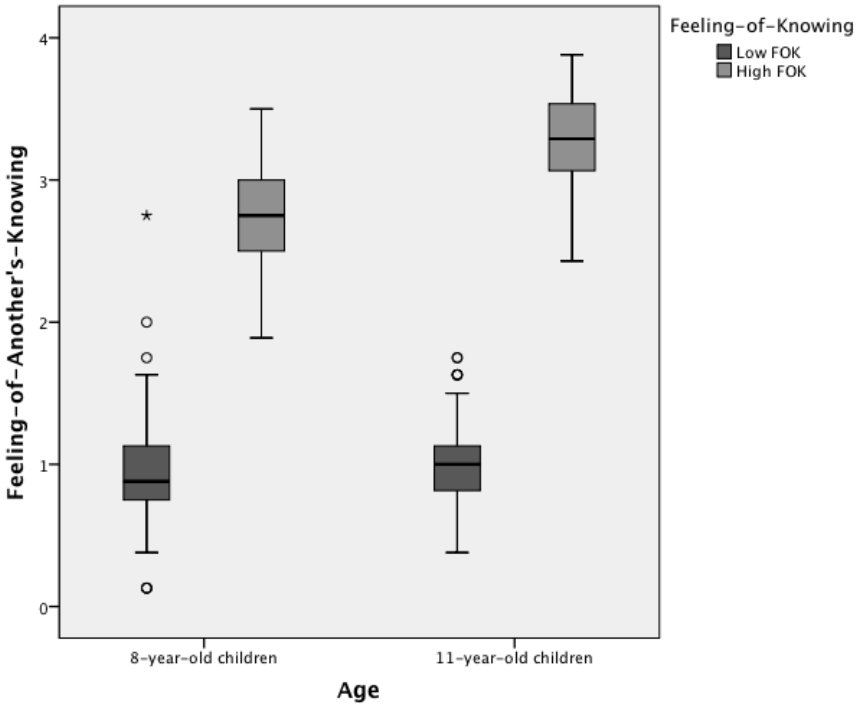

Figure 4.7. Feeling-of-Another's-Knowing (FOAK) scores for judges as a function of age and Feeling-of- Knowing (FOK).

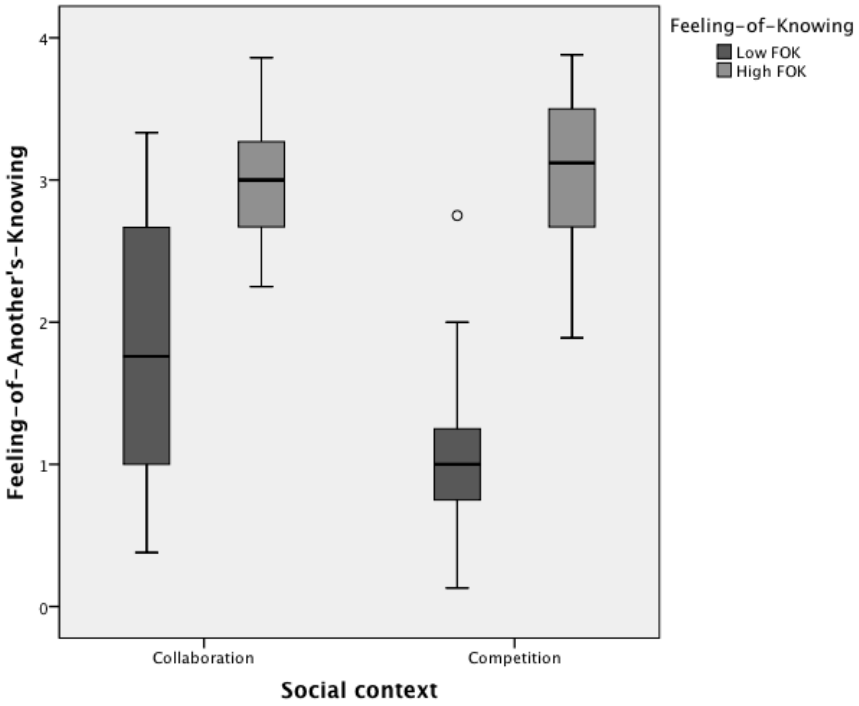

Figure 8. Feeling-of-Another's-Knowing (FOAK) scores for judges as a function of social context and Feeling-of-Knowing (FOK).

Moreover, we found an interaction effect between age and the social setting on the FOAK of participants, $F(1,37) = 83.194$, $p < .001$, $\eta^2_p = .69$. Figure 4.9 shows that 8-year-old children are rated more certain when they are collaborating (M = 2.25, SD = .34) than when they are competing (M = 1.81, SD = .39). However, 11-year-old children are rated more certain when they are competing (M = 2.26, SD = .28) than when they are collaborating (M = 2.03, SD = .23).

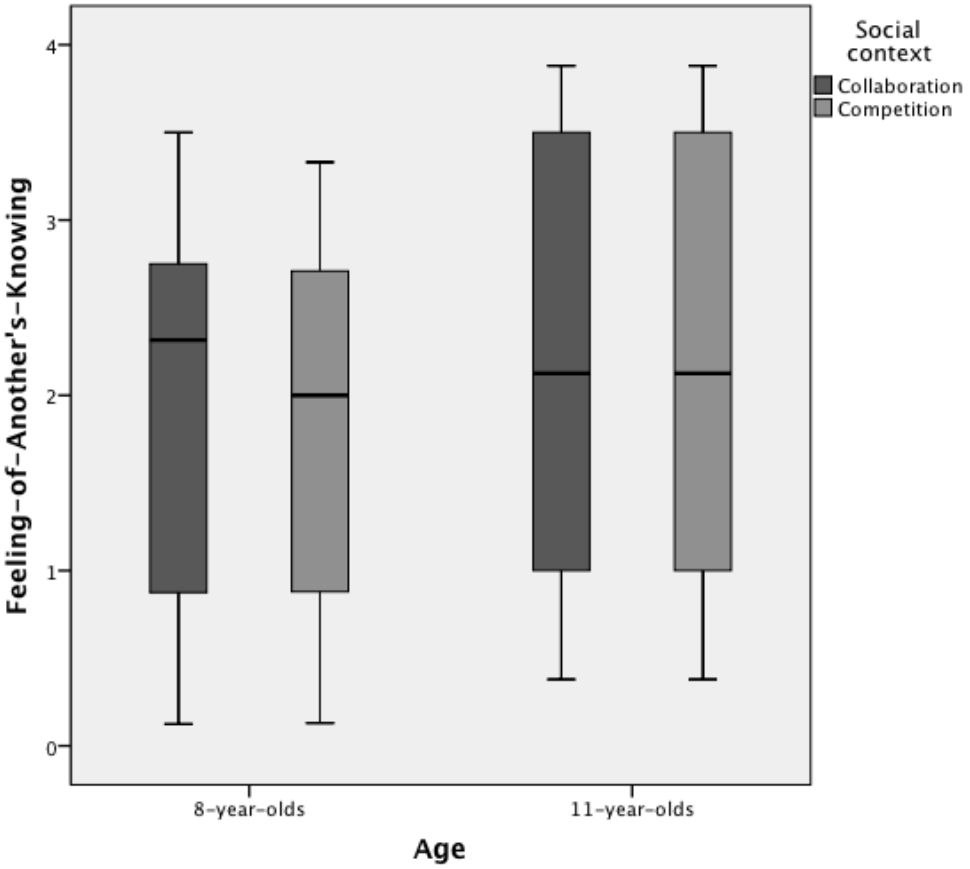

Figure 4.9. Feeling-of-Another's-Knowing (FOAK) scores for judges as a function of social setting and age.

Finally, we found a three-way interaction effect between FOK, age and social setting on the FOAK of participants, $F(1,37) = 7.249$, $p < .05$, $\eta^2_p = .16$. This interaction can be explained by considering Figures 4.10 and 4.11. Again, we found that 8-year-old children are rated more certain in collaboration than in competition and 11-year-old children are rated more certain in competition than in collaboration, similar to the two-way interaction between social setting and age on FOAK described before (see Figure 4.9). However, as Figures 4.10 and 4.11 show, the impact of this interaction is different for low and high FOK reports of the child participants.

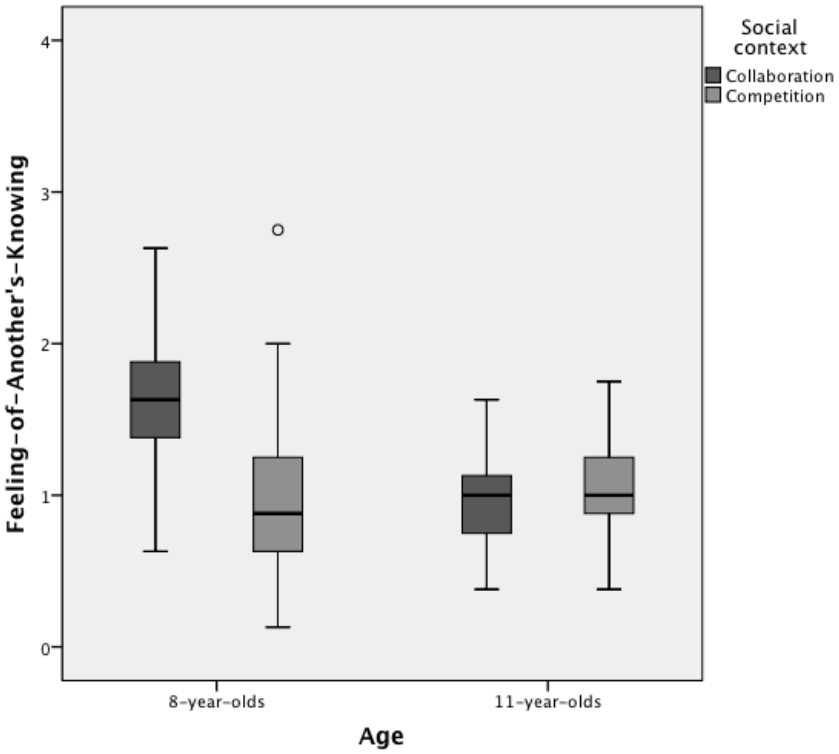

Figure 4.10. Feeling-of-Another's-Knowing (FOAK) scores for judges as a function of social setting and age, for low Feeling-of-Knowing scores.

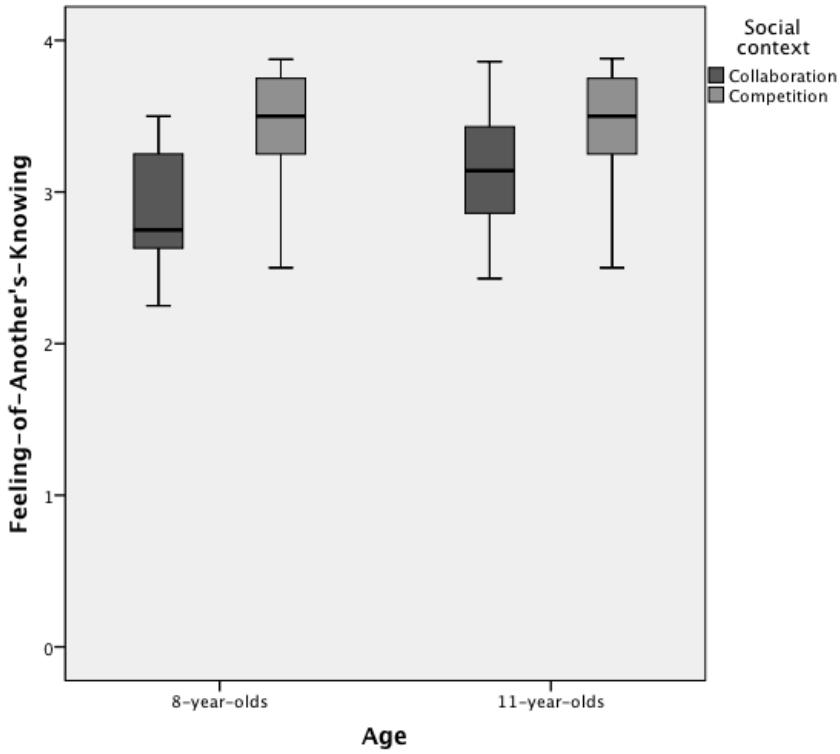

Figure 4.11. Feeling-of-Another's-Knowing (FOAK) scores for judges as a function of social setting and age, for high Feeling-of-Knowing scores.

Discussion

In the perception experiment, participants saw 64 clips of children answering questions and they had to judge the confidence level of the children in the clips. The stimuli contained two age groups and two social conditions. Based on the interaction between age and social setting on FOK found in the first study, we assumed older children's uncertainty to be perceived more clearly than younger children's. Moreover, we expected an effect of the social setting on the perception of FOK for 11-year-old children.

We found a correlation between FOAK and FOK in that low FOK utterances were rated significantly lower than high FOK utterances used in the perception test. In other words, participants were fairly capable of judging children's FOK correctly. Furthermore, we found an effect of both age and social setting on FOAK. Older children were rated more certain than younger children. Additionally,

collaborating children were rated more certain than competing children. However, these main effects are qualified by a number of interactions.

First, the difference in judged certainty between low and high FOK utterances appeared to be smaller for 8-year-old children than for 11-year-old children. Participants rated both high and low FOK scores more correctly for 11-year-old children than for 8-year-old children. Apparently, 11-year-old children used more expression, for both uncertain as well as certain answers. Second, we found an interaction of social setting and FOK on the FOAK-scores. There appeared less difference in participants' judgment of certainty between low and high FOK utterances for collaborating children than for competing children. So, it seems that competing children expressed themselves more clearly in both low and high FOK utterances than collaborating children, although the difference is only substantial for feelings of uncertainty.

Finally, we found interaction effects of age and social setting on the perception of auditory and visual expressions of (un)certainty. Analyses show that 8-year-old children are rated more certain in collaboration and 11-year-old children are rated more certain in competition. This could be due to the increased social awareness of 11-year-old children, compared to 8-year-old children, and to the importance of display rules in both social settings (Gnepp & Hess, 1986; Saarni, 1984). In competition, it may be more important to express certainty than in collaboration, as again, this may impress the opponent and increase one's chances of winning. Children around the age of 11 are more aware of these display rules, and therefore express more certainty in competition than in collaboration. It seems that children in collaboration express their FOK to a lesser extent than in competition.

General Discussion and Conclusion

The goal of this study was to explore the influence of either a collaborative or competitive setting on the expression of (un)certainty in children of different age groups. Therefore, we conducted three studies on how 8- and 11-year-old children signal (un)certainty in audiovisual speech, and how such signals are processed by independent observers.

The first study focused on the influence of two social settings on children's feelings of (un)certainty in two age groups, using the Feeling-of-Knowing (FOK) paradigm. It was interesting to observe that the social setting did not clearly affect 8-year-old children's FOK, while there was an obvious difference for the 11-

year-old children, in that they felt more certain in competition than in collaboration. This discrepancy between the two age groups is in line with their accompanying social developmental stages. According to Piaget (1950), children of 11 years old are more aware of their social appearance than 8-year-old children. Their metacognitive state is further developed and therefore 11-year-old children are more aware of the outcomes of their behavior towards others. As a result, social setting seems to be more important for them than for 8-year-old children. For 11-year-old participants, the average FOK was higher in a competitive setting than in a collaborative setting. As mentioned before, this might be caused by the different goal attainments required by collaboration and competition (Deutsch, 1949). The concept of suiting the other person might be more important in collaboration, due to the participants' share of goal and responsibility. Expectations about correctness may therefore be lower. In competition, participants are more aware of their opponent and therefore it would help if they have a confident attitude. From this first study, we can conclude that as children grow older, the social setting is getting more important for their self-reported confidence level. When children are indeed aware of the social setting, they feel more certain in competition than in collaboration.

In our second study, we focused on the auditory and visual features that could have served as potential cues for signaling (un)certainty, by labeling features in 64 utterances. In line with earlier research by Krahmer and Swerts (2005), we found that, similar to adults, children use more features for expressing uncertainty than for expressing certainty. This suggests that children in both age groups are concerned about self-presentation. Yet, we found that children, contrary to adults, do not systematically use fillers like "uhm" or hedges such as "I think the answers would probably be something like…" to express their uncertainty. This implies that although children seem to be aware of the self-presentational factor of expressing uncertainty, their strategy to signal this may not be as developed as those of adults.

While we did find that various features distinguish between low and high FOK answers, the labeling procedure did not reveal effects of social setting or age. At first sight, this is not in line with the outcome of our first study, which showed an effect of social setting on feelings of certainty in older children. However, this discrepancy could be due to the labeling of a limited set of features in our second study or it might be that a simple binary distinction between absence and presence may not reveal subtle differences between age and social setting. Because we did find an effect of both social setting and age in the first study, we decided to conduct a subsequent experiment, in the form of a perception test.

The aim of this third study was to examine how children's FOK is perceived by adults, and whether there were any differences in that respect between age and social setting. This was done using the Feeling-of-Another's-Knowing (FOAK) paradigm. We found that both social setting and age are important factors for the perception of expressions of (un)certainty. Older children had more obvious FOK expressions than younger children. Apparently, they distinguished the differences in confidence level more clearly than 8 year-old children. For 8-year-old children, expressions of low and high FOK were more alike. This could be explained by the increased knowledge of display rules of 11-year-old children (Saarni, 1981). For them, a self-protective display rule such as showing uncertainty might be more important than for 8-year-old children. Moreover, children in this age group are more developed in their social skills and therefore it might be more important to show certainty as well, as this may impress the opponent and increase one's chances of winning. This is in line with the assumption that children develop their nonverbal behavior as they grow older (Knapp & Hall, 2010). Moreover, it appeared that the competing children's FOK was better recognized than collaborating children's FOK. So, it seems that competing children expressed themselves more clearly (especially in low FOK utterances) than collaborating children. A reason for this could be that in competition the application of self-protective display rules is more important than in collaboration, in line with earlier argumentation.

We also found interaction effects of age and social setting on participants' FOAK, whereby 8-year-old children are rated more certain in collaboration and 11-year-old children are rated more certain in competition. This is in line with the outcomes of our first study, where older children felt more certain in competition than in collaboration. Apparently, they not only feel more certain, they also express this certainty to a higher degree. Again, this shows that when social consciousness is developed, children find expressing certainty more important in competition than in collaboration. When social awareness is less developed, collaboration seems to be the social setting where children appear more certain when answering a question, compared to competitive settings.

In general, our study revealed that as children grow older, social settings like collaboration and competition have an important impact on the expression of (un)certainty. However, specific features that are used for the expression of (un)certainty are still to be studied. Future research should test whether more gradient distinctions in types of features may show differences between different age groups and social settings. For instance, in our studies, we chose a set-up in which participants were able to hear but not see each other. This may have

influenced the relative use of auditory and visual cues for expressing (un)certainty in this experiment. In particular, it could be that the fact that participants could not see each other had a reducing effect on the visual cues. While this is conceivable, it does not seem to be in line with what is known from previous research, which showed that participants relied on both auditory and visual cues of (un)certainty without the explicit presence of other people (e.g. Brennan & Williams, 1995; Krahmer & Swerts, 2005). Arguably, when participants would have been able to see each other, they might have been more inclined to interact with each other, which could have made the interactions less controlled and drawing general conclusions from the experiment would have been more difficult. Therefore, here, we aimed to study the expression of FOK when participants were aware of their social context (collaboration or competition), but could not see the other player. We wanted to know if this awareness of social context had any effect on the use of both visual and auditory cues for (un)certainty. Our results confirm that it actually did. Still, a next step could be to make the social context more interactive (and thereby also more complex, as noted). We might expect the expressions of uncertainty to become even more pronounced, because of the importance of self-protective display rules in a more interactive setting. It would be interesting to vary the interactivity of the setting more systematically in future research to see if this has any effect on the use of specific auditory and visual features.

Social awareness and knowledge of display rules seem to be important for expressing (un)certainty. Comparing the outcomes of our studies, we notice a difference between children's *feeling* of (un)certainty and *expression* of (un)certainty. Children, in the course of their social development, feel more certain under competitive conditions and are even perceived more certain in this setting. However, if we distinguish between their utterances of low and high feelings of certainty, it appeared that both older and competing children have the tendency to show their uncertainty more expressively than younger children and children in collaboration. So, besides that these children are more certain and are also more expressive about it in general, they tend to show their uncertainty more as well. We can explain this by the appliance of expressing uncertainty as a self protective display rule. By expressing uncertainty, face might be saved when an answer turns out incorrect. This is apparently more important for both children of 11 (compared to children of 8), and children in competition (compared with children in collaboration).

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Appendix

English translations of the questions and answers used in study 1. FOK study

1. What is a newborn cow called? (calf)
2. What are the names of Donald Duck's nephews? (Huey, Dewey and Louie)
3. What do we call a story that begins with: Once upon a time... (fairytale)
4. What is leather made of? (cow skin)
5. Where do you go when you want to borrow a book? (library)
6. What is the first name of the mayor of Zoetermeer? (Charlie)
7. What is the name of Ernie's best friend? (Bert)
8. For whom do we sing the song 'kom maar binnen met je knecht'? (Sinterklaas)
9. What is the famous French bread called? (baguette)
10. What is the name of two beds stacked on top of each other? (bunk bed)
11. What do we call a red beetle with black dots? (ladybug)
12. Which class of animals lives in an aquarium? (fish)
13. Of how many people does a soccer team consist? (11)
14. What do we call the person that checks your ticket in a train? (conductor)
15. How much is a dozen? (12)
16. What is a newborn lion called? (cub)
17. What is a permanent drawing on someone's body called? (tattoo)
18. What is the capital city of The Netherlands? (Amsterdam)
19. In which country is Disneyland Paris located? (France)
20. Which year comes after 1933? (1934)
21. Which country established the VOC? (Holland)
22. What is glass made of? (sand)
23. What is the name of the restaurant where you can order a Happy Meal? (McDonalds)
24. What month comes after March? (April)
25. What do we call a car that takes people to the hospital? (ambulance)
26. What do we call the water that sometimes falls out of the sky? (rain)
27. How many months are in a year? (12)
28. What is the holiday period around Christmas called? (Christmas break)
29. Who discovered America? (Columbus)
30. What do we call a talking bird? (parrot)

5

Nonverbal predictors of metacognitive judgments in older adults: Feeling-of-Knowing and its perception

Abstract

The older adults' use of non-verbal expressions accompanying memory retrieval is likely to be affected by lower emotional intensity and changes in knowledge access accuracy. The purpose of this study was to examine whether nonverbal expressions of older adults performing the Feeling-of-Knowing meta-memory task can be used as indicators of memory deficit awareness. Twenty-four older adults (M_{age} = 79.5; range = 70-95) were video-recorded while participating in a Feeling-of-Knowing task. The nonverbal behavior displayed in 460 fragments during the recall phase was manually and automatically annotated (using facial expression detection software) and evaluated. Finally, 42 younger adults (M_{age} = 22.8; range = 18-55) judged a subset consisting of 64 recordings in a perceptual study involving the Feeling-of-Another's-Knowing (FOAK) paradigm. There was an overall effect of FOK ratings on the use of FOK related nonverbal features by older adults. For recalled items, the participants used more nonverbal cues with lower FOKs than with higher FOKs. For unrecalled items, the opposite effect was found. The perceptual study indicated that third-party judges were able to estimate older adults' FOK. Older adults display standard nonverbal cues associated with Feeling-of-Knowing with a level of accuracy comparable to younger age groups.

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Introduction

Oftentimes, when asked a question, we can reliably estimate whether we know the answer or not even before actually retrieving it from our memory. This type of experience is referred to as "Feeling-of-Knowing (FOK)" (Hart, 1965) and is considered to be a form of meta-memory comparable to the well-known tip-of-the-tongue phenomena. Various studies have shown that FOK levels correlate with both verbal and non-verbal expressiveness displayed when responding to questions (Brennan & Williams, 1995; Krahmer & Swerts, 2005; Smith & Clark, 1993). These findings indicate that the presence or absence of particular non-verbal features, employed in the context of monitoring one's memory, signal an individual's awareness of memory deficits.

Research on children and younger adults showed a link between FOK accuracy and nonverbal cues (Krahmer & Swerts, 2005; Visser, Krahmer & Swerts, 2014) but there are at least three reasons to assume that the findings might not extend to an older population. First, in older age groups, FOK accuracy appears to decrease at least for some types of knowledge, like in memory tasks involving a study phase of paired-associate items (Souchay, Isingrini, & Espagnet, 2000; Souchay, Moulin, Clarys, Taconnat & Isingrini, 2007). Admittedly, the decrease is not always found when the experimental procedure is modified (Eakin & Hertzog, 2012; Hertzog, Dunlosky, & Sinclair, 2010) or when other types of memory tasks, such as those involving semantic memory, are used (MacLaverty & Hertzog, 2009). A potential decrease in accuracy may, in any case, affect the accompanying non-verbal behavior. Second, older adults are arguably less expressive than younger adults or children (Levenson, Carstensen, Friesen & Ekman, 1991; Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Gross et al., 1997; Levenson et al., 1991). Although findings on expressions of positive emotions are mixed, negative emotions like fear and anger appear to be less intense in older adults, compared to young adults (Carstensen et al., 2000; Gross et al., 1997; Levenson et al., 1991), possibly due to a better-developed emotion regulation mechanism (Charles & Carstensen, 2007; Gross et al., 1997; Levenson et al., 1991). Third, the use of non-verbal expressions by older adults may be affected by the higher frequency of the experienced retrieval failures (Burke, MacKay, Worthley & Wade, 1991; Gollan & Brown, 2003) and tip-of-the-tongue states (Brown, 1991). Older adults are more prone to word retrieval failures than younger adults (Burke et al., 1991; Gollan & Brown, 2003), quite likely due to their greater vocabulary knowledge (Burke et al., 1991).

In the research reported here, we set out to obtain a comprehensive overview of the non-verbal cues displayed by older adults, using a variant of the FOK paradigm, as applied in earlier question-answering studies (Brennan & Williams, 1995; Krahmer & Swerts, 2005; Smith & Clark, 1993). In the original paradigm due to Hart (1965), also referred to as the recall-judgment-recognition paradigm, participants are exposed to a three-step procedure starting with a series of general knowledge questions. In response to these questions (i.e., "What is the capital of Switzerland?"), participants are either able to recall the answers ("Bern") or not ("I don't know"). Subsequently, for the unrecalled items, participants are asked to judge whether or not they believe they would be able to recognize the correct answer among several wrong alternatives, when presented in a multiple-choice test. Hart (1965) referred to the participants' judgment elicited during the second step in the procedure as their Feeling-of-Knowing. In the last part of the procedure - the recognition – they are given a multiple-choice test and asked to select the correct answers to the previously queried items.

FOKs serve as assessments that information is available in memory, even when it has not been retrieved (e.g., Eakin & Hertzog, 2012; Hart, 1965; Singer & Tiede, 2008). In the course of answering questions, people undergo several alternating processes. While being questioned, people actively search in their memory for the correct answer. Simultaneously, this retrieval is monitored on a meta-cognitive level. This means that while formulating or searching for the correct answer, people are continuously evaluating whether they expect to be capable to answer the question correctly or not (Koriat, 1993; Nelson & Narens, 1990). FOK can be used as guidance for monitoring the search for an answer and can help in deciding to continue the search or resign oneself to an unsuccessful retrieval.

Traditionally, in psychological studies, FOK is used to describe solely *prospective* memory tasks, i.e., the feeling of being able to recognize a correct answer for previously unrecalled items (Hart, 1965). In psycholinguistic literature, on the other hand, FOK is typically examined on a par with indications of confidence (e.g., Brennan & Williams, 1995; Krahmer & Swerts, 2005; Wollerman & Lasarcyk, 2007). In this case, FOK is used to describe both *prospective and retrospective* memory tasks, and refers to the participant's estimate of being able to recognize the correct answer both for recalled and unrecalled items. Since the outcomes of psycholinguistic studies on (non)verbal expressions of FOK show similarities between signals of high FOK for unrecalled items and low FOK for recalled items, this study investigates FOK in both contexts.

Past studies of nonverbal cues associated with FOK identified specific visual and auditory cues displayed during the task (Corley & Stewart, 2008; Kimble & Seidel, 1991; Krahmer & Swerts, 2005; Pon-Barry & Shieber, 2011; Smith & Clark, 1993; Stone & Oh, 2008; Swerts & Krahmer, 2005; Wollermann & Lasarcyk, 2007; Wollermann & Schröder, 2009). For instance, a high FOK experienced for previously unrecalled items is typically signaled by auditory cues including *linguistic hedges* and *fillers* such as 'perhaps' (Smith & Clark, 1993) and 'um' (Corley & Stewart, 2008), as well as by visual cues, like *averted gaze* or *brow movements* (Swerts & Krahmer, 2005). Similar cues appear to be used for low FOK in the case of recalled items, together with utterance-final *high intonation* (Scherer, London & Wolf, 1973; Wollermann & Lasarcyk, 2007; Wollermann & Schröder, 2009), or visual cues like *smiles* and *"thinking faces"* (Swerts & Krahmer, 2005).

In the study reported here, we set out three objectives. First, we explored older adults' metamnemonic awareness in relation to their use of nonverbal cues for varied degrees of FOK experiences. To our knowledge, the nonverbal behavior accompanying FOK in an older age group has not been studied before, despite the fact that there are reasons to believe it may differ from younger age groups due to the differences outlined above. The nonverbal features were manually coded, based on a coding scheme used in earlier FOK studies (e.g., Swerts & Krahmer, 2005). Given that this existing set of cues is identified for younger age groups and only involves a limited pre-defined set of cues, we also analyzed the visual features with the help of a more comprehensive automatic procedure. Second, we compared older adults' FOK nonverbal cues of *recalled* items (answers) and *unrecalled* items (non-answers), where earlier FOK studies seem to focus merely on either recalled or unrecalled items, or merge the two categories. As a third and final objective, we explore the decoding of FOK cues displayed by the older participants by third-party judges (in the literature referred to as "Feeling-of-Another's-Knowing", FOAK for short; see Brennan & Williams, 1993; Krahmer & Swerts, 2005; Visser et al., 2014). Assuming that the non-verbal cues associated with FOK fulfill, at least partly, social functions, we expect them to be recognized by independent observers.

Production Experiment

Method

Participants. In total, 24 participants (12 female) took part in the production experiment. Prior to the analysis, the data of one of the female participants had to be discarded due to a recording error, resulting in a sample of 23 participants. The participants were cognitively active, independently living seniors who required little or no assistance with activities of daily living and no regular medical assistance. They were selected from seniors living in a retirement community in Rotterdam (N = 16) and participating in an activity center in Tilburg (N = 8), The Netherlands, on the basis of the organizer/caretaker recommendations. Participants' age ranged from 70 to 95 years (M = 79.5, SD = 6.3). They participated voluntarily for no remuneration and there was sufficient time allowed for reflection and consultation between the decision to participate in the study and the actual recording session. None of the participants reported hearing and eyesight decrements that would make the participation in the task difficult, or showed signs of a compromised decision-making capacity. The group consisted of participants with elementary or secondary level education. Beforehand, participants signed a consent form by which they gave permission to be filmed during the experiment and for the recordings to be used for scientific purposes. Approval for the study was obtained from the Institutional Review Board, Faculty of Humanities, Tilburg University; the recruitment and the experimental procedure followed the guidelines of the Institutional Review Board.

Stimuli. Similar to earlier Feeling-of-Knowing studies (Krahmer & Swerts, 2005; Smith & Clark, 1993; Visser et al., 2014), non-verbal expressions were elicited by asking participants knowledge questions in a quiz-like setup. In order to collect a substantial amount of lexically distinct answers, while keeping the duration of the experiment within reasonable limits, participants were exposed to one of two question sets, each of which contained twenty knowledge questions. The sets were partly adapted from earlier research by Krahmer and Swerts (2005), who selected their questions from Trivial Pursuit board games and general intelligence tests. Both clusters of questions resulted in answers that were likely to be either easy or hard to retrieve. To prevent feelings of frustration, participants were assured beforehand that the range of question difficulty varied and they were not expected to be able to answer all questions correctly. The question sets were pretested with four older adults (65 to 92 years old) who were not a part of the experimental group. They provided both answers and non-

answers to the questions in the sets. For a complete overview of the two question sets, see the Appendix.

Experimental procedure. The production experiment took place in quiet environments familiar to the participants (their home or the common room of their daily activity center). Following the FOK paradigm as designed by Hart (1965), participants underwent a three-step procedure, without any time restrictions. At the beginning of each step, they were explicitly given the opportunity to withdraw their further participation. The experimenter and the camera operator (both female) were dressed in casual clothes to prevent an authoritative look. The experimenter explained the purpose of the experiment in a simple language with a slow-to-moderate speech tempo.

First, participants were asked to answer a series of twenty questions, presented orally to them by the experimenter. Participants sat in a chair in front of a video camera that recorded them during the experiment. They were not given any feedback about the correctness of their answers, but after completion of the experiment, the correct answers were provided upon request. The experimenter was positioned behind the camera and aimed to respond to comments of the participants as little as possible, except repeating a question if needed. In this way, participants were unable to pick up feedback cues about the (in)correctness of their answers.

In the second part of the experiment, the participants were given a paper form, which listed the exact same sequence of questions. For each question, participants were asked to indicate (on a seven-point Likert scale) how certain they were that they would recognize the correct answer if it was presented in a multiple-choice test (the Feeling-of-Knowing score, 1 representing 'not certain at all', 4 representing, 'neither uncertain nor certain', 7 representing 'very certain'). Because older adults may have difficulties with interpreting Likert scales, the experimenter assisted them in filling out the scores.

In the third and last part of the experiment, the same set of questions was presented again, this time as a multiple-choice test in which the correct answer was mixed with three plausible alternatives. Participants were urged to respond to every question, even if this meant they had to guess.

Results

Types of responses

All 23 participants were asked twenty questions; in total, 460 utterances were collected in the production experiment. Recordings contained correctly recalled items (N = 192), incorrectly recalled items (N = 75) and unrecalled items (N = 193). The majority of the FOK scores were of level 7, in line with the attempt to make most of the questions easy to answer to prevent participants' discomfort, leaving a sufficient number of lower FOK scores to be used in follow-up measurements.

FOK and recall

Analysis of variance showed that mean FOK ratings were higher for recalled items than for unrecalled items (with participants as random factor, $F1(1, 22) = 2.36$, $p = .001$, $\eta^2_p = .11$; with items as random factor: $F2(1, 19) = 2.33$, $p = .001$, $\eta^2_p = .10$). Moreover, participants indicated higher FOK ratings for correctly recalled items than for incorrectly recalled items, (with participants as random factor, $F1(1, 21) = 2.18$, $p = .003$, $\eta^2_p = .17$; with items as random factor: $F2(1, 17) = 2.20$, $p = .005$, $\eta^2_p = .14$). Average FOK scores as a function of different answer categories are presented in Table 5.1.

Table 5.1. Average FOK ratings for different response categories.

Response category		*N*	FOK *Mean*	FOK *SD*
Open questions	All answers	267	6.35	1.25
	Corrects answers	192	6.79	.65
	Incorrect answers	75	5.23	1.64
	All non-answers	193	2.88	2.16
Multiple choice questions	Correct answers	311	5.65	2.13
	Incorrect answers	149	3.33	2.20

FOK's for unrecalled items only

In order to establish the accuracy of the FOK judgments, we compared the FOK ratings of unrecalled items that were correctly recognized, to the FOK ratings of incorrectly recognized unrecalled items. A T-test for independent samples revealed a significant difference between the two groups, $t(183.95) = 2.88$, $p = .004$ (equal variances not assumed). The FOK scores were higher for correctly recognized unrecalled items ($M = 3.32$, $SD = .51$) than for the incorrectly recognized items ($M = 2.44$, $SD = .39$), indicating that participants were accurate at predicting the recognition outcome.

Following the standard procedures of estimating FOK *accuracy*/*association* (Nelson, 1984; Reggev, Zuckerman, & Maril, 2011; Schraw, 1995; Souchay, Isingrini, Clarys, Taconnat & Eustache, 2004), we also calculated a Goodman-Kruskal gamma correlation and the Hamann difference index (a proportional measure ranging from -1 to +1). These two measures are assumed to provide independent information about the performance on the Feeling-of-Knowing task. The gamma correlation which, according to Nelson (1984), represents the relative metacognitive accuracy most properly, was $\gamma = .30$, $p = .005$. In order to calculate the Hamann difference index, the FOK scores were recoded into binominal scores (scores of 1-3 in a low FOK score of 0; scores of 5-7 in a high FOK score of 1; original scores of 4 not included, resulting in 10% of missing values (17 cases out of 176)). The Hamann difference index was calculated by taking the coefficient difference between the proportions of correct and incorrect predictions (see Figure 5.1), resulting in the value of .19.

		Recognition	
		Correct	Incorrect
Feeling of Knowing	High	a	b
	Low	c	d

$$HC = \frac{(a + d) - (b + c)}{(a + d) + (b + c)}$$

Figure 5. 1. Calculation of Hamman Coefficient difference between the proportions of correct and incorrect predictions.

FOK and nonverbal cues

Coding. All 460 utterances were manually transcribed and categorically coded for the presence or absence of the auditory and visual features as described in Table 5.2, based on earlier studies. With respect to vocal features, Brennan and

Williams (1993) found correlations between Feeling-of-Knowing and the use of delays, fillers and high intonation, when answering a question. Similar to the study of Krahmer and Swerts (2005), we based the three visual features on the Facial Action Coding System by Ekman and colleagues (e.g., Ekman & Rosenberg, 1997). In this system, facial expressions are described by means of Action Units (AUs), i.e., numbered muscular actions: smiling is related to AU 12, 13 and/or 14; eye brow movement is related to AU 1 and/or 2; and a puzzled face is related to AU 14, 15, 18, 20 and/or 24, which describe lip movements, like lip pucker and dimpler in combination with AU 1, 2, and/or 5, which describe eyebrow movements, and AU 9 for a nose wrinkle. For representative examples of visual features used by participants, see Figure 5.2.

Table 5.2. Descriptions of coded features.

	Feature	Description
Auditory	Filler	The use of fillers (like "um", or "I'm not sure, but I think this is…").
	Intonation	Ending an answer with a high boundary tone.
	Delay	A silence for more than 1 second, preceding an answer.
Visual	Eye brow movement	Moving (one of) the eyebrows from neutral position.
	Smiling	Moving the corners of the lips upwards.
	Puzzled face	Expressing a typical "thinking face", defined here as a combination of brow movements, possible nose wrinkle and lip pucker/dimpler (previous studies referred to this as the "funny face", e.g. Krahmer & Swerts, 2005).

Following an explicit labeling protocol based on the FOK study of Visser et al. (2014), two independent coders labeled part of the data (15%) with acceptable inter-coder agreements (Cohen's Kappa's were .86 for *fillers*, .72 for *high intonation*, .69 for *delays*, .69 for *eyebrow movements*, .78 for *smiling* and .65 for *puzzled faces*); the remaining utterances were labeled by one individual coder. Both coders were blind to FOK ratings and the questions preceding the utterances.

Figure 5.2. Stills illustrating the labeled visual features
(from left to right: eyebrow movement, smiling and puzzled face).

FOK and expressivity

An analysis of variance showed an overall effect of FOK ratings on the use of FOK nonverbal features in recalled items, $F(1, 266) = 11.75$, $p < .001$, $\eta^2_p = .21$; with lower FOKs, participants used more FOK nonverbal features than with higher FOKs. For unrecalled items, there was an opposite effect, $F(1, 266) = 5.99$, $p < .001$, $\eta^2_p = .16$; participants were more expressive for high FOK non-answers than for low FOK non-answers.

Specifying nonverbal cues

The labeled features were analyzed individually by means of paired sample T-tests for all items, comparing the FOKs in the presence and absence of a feature. Table 5.3 shows that the presence of the nonverbal features in recalled items corresponds with a lower FOK rating, with the exception of *eyebrow movement* and *smiling*. Contrasting results are shown in Table 5.4, which displays the presence and absence of nonverbal features in unrecalled items. For delay and high intonation, the FOKs were higher when the nonverbal feature was present compared to when it was absent.

Table 5.3. Mean individual FOK ratings (and standard deviations) for the recalled items as a function of presence and absence of FOK nonverbal features (in which N represents the number of participants used to calculate individual means).

	N	Present	Absent	Difference
Filler	22	6.04 (0.66)	6.54 (0.81)	-0.50 (1.00)*
Delay	17	5.37 (1.50)	6.45 (0.47)	-1.08 (1.39)**
High intonation	20	5.35 (1.62)	6.52 (0.52)	-1.70 (1.52)**
Eyebrow	22	6.07 (0.84)	6.43 (0.64)	-0.36 (0.99)
Smile	15	6.21 (0.71)	6.45 (0.41)	-0.24 (0.84)
Puzzled face	8	4.13 (1.89)	6.13 (0.74)	-2.01 (2.15)*

** p < .05, ** p < .01*

Table 5.4. Mean individual FOK ratings (and standard deviations) for the unrecalled items as a function of presence and absence of the FOK nonverbal features (in which N represents the number of participants used to calculate individual means).

	N	Present	Absent	Difference
Filler	19	3.56 (1.57)	2.25 (1.40)	1.31 (1.89)*
Delay	19	4.32 (1.72)	2.66 (1.36)	1.67 (2.09)*
High intonation	4	4.50 (2.38)	3.21 (1.90)	1.29 (1.67)
Eyebrow	20	3.14 (1.43)	2.95 (1.42)	0.19 (1.36)
Smile	13	3.70 (1.60)	3.19 (1.36)	0.50 (1.93)
Puzzled face	17	3.43 (2.29)	2.92 (1.19)	0.51 (1.90)

** p < .01*

Automatic Analysis

Given that the manual coding was based on an existing, pre-determined set of cues identified for younger age groups, in addition to the manual labeling procedure, we analyzed the visual features with the help of a comprehensive automatic procedure as well. For this end, we used the software tool for frame-based automatic facial expression recognition CERT (Computer Expression Recognition Toolbox; Littlewort et al., 2011). Based on a machine-learning

algorithm, the tool identifies the face region in a video and detects with a reasonably high accuracy comparable to human annotators the 44 Facial Action Units in the Facial Action Coding System (Ekman & Rosenberg, 1997). In total, 440 video fragments were analyzed for the averaged probability of a particular facial action unit being present in the fragment. Twenty fragments were discarded because the software was unable to detect the facial region reliably. The set of fragments contained both recalled (57%) and unrecalled (43%) items.

In order to explore a possible link between FOK and different facial action units, we performed a multiple regression analysis for the two conditions (recalled, unrecalled) separately. Prior to the analysis, we excluded all weakly correlated variables (Berry, 1993) ignoring action units with correlations < .3 between a given unit and FOK. The correlations for the remaining variables are presented in a zero-order correlation matrix in Table 5.5 (recalled items) and Table 5.6 (unrecalled items). The correlation analyses revealed no coefficients exceeding > .9 between the action units selected as predictors in the regression models, thus satisfying the assumption regarding multi-collinearity.

Table 5.5. Feeling-of-Knowing and Action Units: Descriptives and Zero-Order Correlations for Recalled Items (N = 245).

Variable	*M*	*SD*	1	2	3	4	5	6
1. FOK	5.82	2.04	_					
2. Dimpler (AU14)	1.09	0.53	-.31**	_				
3. Chin Raise (AU17)	1.30	0.54	-.29**	.26**	_			
4. Lip Pucker (AU18)	-0.01	0.02	-.40**	-.03	.31**	_		
5. Lips Part (AU25)	0.88	0.43	.28**	.11	-.22**	-.30**	_	
6. Fear Brow (AU1+2+4)	-3.08	0.38	.41**	-.36**	-.33**	-.01	-.01	_

Note. ** p < .01.

Table 5.6. Feeling-of-Knowing and Action Units: Descriptives and Zero-Order Correlations for Unrecalled Items (N= 195).

Variable	*M*	*SD*	1	2	3	4
1. FOK	3.02	2.35	_			
2. Nose Wrinkle (AU9)	0.29	0.09	-.27**	_		
3. Dimpler (AU14)	1.11	0.45	-.29**	-.24**	_	
4. Lids Tight (AU7)	0.33	0.20	-.26**	.72**	-.04	_

Note. ** p < .01.

The regression analysis for recalled items revealed a significant effect of four of the five action units, i.e., the *dimpler, lip pucker, lip parting*, and the *fear brow*. For unrecalled items, two of the three action units were significantly related to the FOK score, namely, the *dimpler* and *nose wrinkle*. In addition to the AUs associated with the puzzled face used in the manual labeling (*nose wrinkle, dimpler* and *eye brow* movement), the comprehensive automatic analysis thus helped to identify other cues associated with FOK for recalled items, namely parting of the lips and a particular eyebrow expression, the 'fear brow'. Moreover, different cues appear to be predictive of the FOK scores for recalled items compare to unrecalled items. See Table 5.7 for an overview of the regression analyses.

Table 5.7. Linear Regression Models Predicting FOK by Facial Action Units.

	Recalled Items			Unrecalled Items		
	B	*SE*	*β*	*B*	*SE*	*β*
(Constant)	11.038	0.859		7.928	0.739	
Fear Brow	1.739***	0.286	.335***	-	-	-
Lip Pucker	-38.991***	5.993	-.351***	-	-	-
Lips Part	0.961***	0.254	.206***	-	-	-
Dimpler	-0.849***	0.208	-.227***	-1.932***	0.351	-.368***
Chin Raise	0.117	0.220	.031	-	-	-
Nose Wrinkle	-	-	-	-9.660**	1.833	-.332**
Lids Tight	-	-	-	-0.385	1.155	-.032
R^2	.40	**		.20	**	
F	31.29	**		15.630	**	

Note. *p < .05, ** p < .01 and *** p < .001.

Perception Experiment

In the final part of the research reported here, we examined to what extent the nonverbal cues displayed by the older participants could be interpreted as cues to Feeling-of-Knowing by third-party judges (Feeling-of-Another's-Knowing, FOAK, Brennan & Williams, 1993).

Method

Participants. Forty-two adults participated as third-party judges in the perception study (24 women). Their average age was 22.8 years old (SD = 6.0). All participants were students of Tilburg University and received course credits for their input.

Stimuli. In total, sixty-four utterances were selected from the corpus collected in the production study, with an equal distribution of answers and non-answers, and low and high FOK scores. Given the individual differences in the use of the FOK scale, the lowest or second lowest (or highest and second highest) score for all answers of that particular participant were used as instances of a low (or high) FOK score. Note that the categorization of low (and high) FOK utterances could differ between participants. For example, when participant A indicated a lowest FOK score of 3, and participant B lowest score indicated was 1, both scores would be assigned as a low FOK score. This gave a 2 × 2 design (high/low FOK ×

answer/non-answer). The stimuli for the perception test were randomly selected in a first round, but utterances were iteratively replaced until the following criteria were met: firstly, the answers given in the selected clip had to be lexically different from each other to avoid that participants in the perception test would have to judge clips with similar content. Secondly, the speaker should appear in clips representing all four conditions (answer/non-answer x high/low FOK). To assure judgments were only based on the (non)verbal expression of the speaker, and not on the participants' own estimation of the correctness of answers, stimuli were presented without the questions that preceded answers.

Experimental procedure. Participants were placed behind a computer screen in an isolated booth. On the screen, two sets of thirty-two stimuli (answers and non-answers) were presented one by one. First, the set containing only answers was shown in one of two random orders. Participants saw the stimulus ID (1 to 32) and then the actual stimulus. During a stimulus-interval of three seconds, participants were instructed to estimate to what extent speakers were certain about their answer, on a seven-point Likert scale (the FOAK score). After participants had finished this first set, a second set of thirty-two stimuli was presented in one of two random orders, containing only non-answers. A stimulus ID was presented (33-64) before the actual stimulus and the three seconds stimulus interval. Participants were asked to estimate the chance for the speaker to recognize the correct answer when the question would have been presented as a multiple-choice question instead. Participants were to judge this on a seven-point Likert scale (again the FOAK score). To get familiar with both tasks, participants practiced with example stimuli beforehand.

Results

Since the perception test consisted of two sets of stimuli, we conducted two repeated measures analyses (one for recalled and one for unrecalled items) with the participants' judgment scores (FOAK) as independent variable and FOK (high or low) as factor. Participants were able to estimate speakers' FOK correctly for recalled items, $F(1, 41) = 976.28$, $p < .001$, $\eta^2_p = .96$. Speakers' high FOK recalled items were judged as more certain than speakers' low FOK recalled items (high FOK: $M = 5.39$, $SD = .43$; low FOK: $M = 2.83$, $SD = .47$). A comparable effect was found with respect to FOK for unrecalled items, $F(1, 41) = 403.93$, $p < .001$, $\eta^2_p = .91$. This means that speakers were judged as more capable of recalling a correct answer if presented in a multiple choice test, when they responded with a

high FOK unrecalled item than when they responded with a low FOK unrecalled item (high FOK: $M = 4.33$, $SD = .56$; low FOK: $M = 2.40$, $SD = .54$).

General Discussion and Conclusion

The purpose of our research was to examine older adults' Feeling-of-Knowing experiences and their use of nonverbal cues for both recalled and unrecalled items. For this aim, we conducted a quiz-like production experiment with older adults, using the standard recall-judgment-recognition procedure, in which we collected recordings of a variety of answer utterances and accompanying FOK scores. We coded all utterances for the presence of various cues (manually and automatically) and presented a selection of utterances to third-party judges in a perception test.

The results of our study support the view that older adults are able to produce an accurate FOK, both for recalled and unrecalled items. With regards to recalled items, participants indicated higher FOK ratings for correctly recalled items than for incorrectly recalled items. Additionally, FOK scores were higher for correctly recognized unrecalled items than for the incorrectly recognized ones. The values of the Gamma correlation and the Hamann index found for our participant group were comparable to the values found in other studies with older adults (Souchay et al., 2004: $\gamma = .22$ (Episodic), Hamann = .25 (Episodic); Souchay et al., 2007: $\gamma = .24$ (Episodic), $\gamma = .46$ (Semantic), compared to $\gamma = .30$ and Hamann = .19 in our study involving semantic memory). Overall, these results indicate that older adults may be as accurate at assessing their performance in a metamnemonic task as younger age groups (e.g., Hart, 1965; Krahmer & Swerts, 2005), who have been reported to perform with Hamann = .21 and $\gamma = .64$ on a semantic memory task by Reggev et al. (2011).

With respect to nonverbal cues associated with FOK, we expected the older participants to signal their FOK differently than younger age groups. In particular, earlier research has shown that emotional expressiveness appears to decrease with age (Carstensen et al., 2000; Gross et al., 1997; Levenson et al., 1991), therefore, one might expect older adults to suppress their FOK expressions. In general, our manual coding study showed an overall effect of FOK ratings on the use of FOK related nonverbal features in recalled items. More specifically, with lower FOKs, older participants used more of the FOK cues previously identified in studies of younger adults and children, than with higher FOKs. For unrecalled items, we found the opposite effect; participants were more expressive for high

FOK non-answers than for low FOK non-answers. We can conclude that similarly to younger age groups, older adults tend to display cues to low FOK, despite their potentially lower emotional expressiveness. A possible explanation is the interpretation of FOK expressions as having a self-presentational, face-saving nature: expressing a low FOK might lower recipients' expectations regarding the speaker's mnemonic performance (Smith & Clark, 1993). Since according to Charles and Carstensen (2007), the decline in expressiveness is caused by a better-developed emotion regulation system by older adults, this would explain why they express their FOK similarly to younger adults.

The specific cues older adults use to signal their FOK for recalled items include the presence of *fillers*, *delay, high intonation* and *puzzled face*, according to the manual coding. In addition, the automatic analysis helped to detect movements involving the lip area, i.e.*, lip parting* (AU25) and the *fear brow* (AU1+2+4). In the case of unrecalled items, for delay and high intonation, the FOKs were higher when the nonverbal feature was present compared to when it was absent. Even though the manual labeling did not identify any relevant visual features, with the help of the automatic analysis we found the effect of a *nose wrinkle* (AU9) and *dimpler* (AU14) for unrecalled items as well, thus adding to the list of FOK cues used by older adults.

Finally, we examined how the FOK of older adults would be perceived by third-party judges, by using the Feeling-of-Another's-Knowing (FOAK) paradigm. The outcomes of the perceptual task showed that signals of FOK seem to be quite robust perceptually, as the judges were able to estimate speakers' FOK correctly. These results are similar to FOAK studies with younger age groups (Brennan & Williams, 1993; Krahmer & Swerts, 2005).

To conclude, this study shows that older adults display nonverbal cues associated with memory deficits in a manner comparable to younger age groups. Future FOK studies can distinguish between different functions of the nonverbal cues and their effect on third-party judgments. In particular, it could be the case that some expressions are automatic and primarily associated with the affective (e.g., movements of the lips) and cognitive states experienced by the participant (e.g., eye brow movement), while others serve a more communicative function (hedges, filled pauses).

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Appendix

Question set 1 (translated from Dutch, answers between brackets).

1. How much is a dozen? (12)

2. Which is the longest running soap opera on Dutch television? (Goede Tijden Slechte Tijden)

3. Which football club plays at the Philips stadium in Eindhoven? (PSV)

4. Who is the author of "The discovery of heaven"? (Harry Mulisch)

5. What is the highest mountain in the Alps? (Mont Blanc)

6. How many degrees are in a circle? (360)

7. What is glass made from? (sand)

8. What is a "Friese doorloper"? (ice skate)

9. Who is the head of state of the Vatican? (the Pope)

10. What is the capital of Switzerland? (Bern)

11. In the Middle Ages, which disease was known as "The Black Death"? (de Pest)

12. What is the pseudonym of the Mexican Don Diego de la Vega? (Zorro)

13. How many months does it take the moon to circle the earth? (one)

14. What color of light is used on the starboard side of a boat? (green)

15. In the Bible, who went to look for mustard? (Abraham)

16. What do we call a story that begins with: Once upon a time... (fairytale)

17. What does the word 'Jihad' mean? (holy war)

18. On which continent does the Sahara lie? (Africa)

19. What is the chemical symbol for water? (H20)

20. What is a newborn lion called? (cub)

Question set 2. (Translated from Dutch, answers between brackets).

1. Where do you go when you want to borrow a book? (library)

2. Which television series revolves around the Forrester and Spectra families? (Bold and the Beautiful)

3. What is the capital of Holland? (Amsterdam)

4. What does the abbreviation "Fl" for the Dutch guilder stand for? (florijn)

5. What is the boiling temperature of water? (100 degrees)

6. In which country did the Inca's live? (Peru)

7. What is leather made of? (cow skin)

8. Which famous singer was also known as "The King"? (Elvis Presley)

9. What is Rembrandt's last name? (van Rijn)

10.On which continent does Brazil lie? (South America)

11. Who made the drawings for "Jip and Janneke"? (Fiep Westendorp)

12. After the Bible, which novel about a knight is the most reprinted book? (Karel ende Elegast)

13. Who, according to legend, was the bishop of Myra? (Saint Nicolas)

14. What is the largest mammal? (blue whale)

15. What are Donald Duck's nephews called? (Huey, Dewey and Louie)

16. Who wrote the Iliad? (Homerus)

17. What are the sticks used in golf called? (golf club)

18. What is the capital of Spain? (Madrid)

19. How many darts is a player allowed to throw in one turn? (3)

20. What is a newborn cow called? (calf)

6

General discussion and conclusion

This dissertation took a developmental approach to nonverbal expressions of emotion, and specifically examined to what extent social contextual factors have an impact on these expressions. To this end, we conducted a number of experimental studies, in which we aimed to elicit spontaneous emotional reactions in a dynamic but controlled way. Our participants were of different age groups, from primary school children to older adults, and were analyzed as a function of the social context they were in (e.g., competition versus collaboration, alone versus in the presence of a peer).

We tried to gain more insight into the way social context influences nonverbal emotional expressions by conducting a series of studies, described in the four core chapters of this dissertation. The first study, in Chapter 2, investigated to what extent the nonverbal expression of the basic emotion of surprise is affected by situational factors. More specifically, we examined surprise reactions of children and adults while varying the cause of the surprise (unexpectedly correct answers versus unexpectedly incorrect answers) and the social context in which the emotion occurred (collaboration versus competition). Next, Chapter 3 described a study that focused on children's expressive behavior when they receive a disappointing gift or a satisfying gift and whether this is affected by the presence of a peer. More specifically, this study analyzed whether children's expressive behavior differed when a peer receives a gift that is judged to be better or worse than the one they just received. Moreover, we studied how children's nonverbal expressions may change in the course of their response. In doing so, we were specifically interested in the extent to which changes in children's assessment of the social contact (which we operationalized as the children's reaction before and after eye contact with their peer) had an impact on their emotional expressions. Whereas Chapters 2 and 3 mainly focused on the expression of what has traditionally been considered to be basic emotions, the studies described in Chapters 4 and 5 were concerned with the nonverbal expression of a non-basic, socially constructed emotion, namely uncertainty. To elicit nonverbal expressions that varied in levels of (un)certainty, we used variations of the Feeling-of-Knowing paradigm (Hart, 1965). Chapter 4 described a game-like Feeling-of-Knowing experiment with child participants, in which we varied the social context of the game (collaboration versus competition). The study on which we reported in Chapter 5 provided insight into expressions of uncertainty by older adults. In this way, we were able to get an overview of how nonverbal expressions of emotions develop as people grow older.

In this final chapter, we discuss our findings according to the three central themes described in the general introduction of this dissertation: nonverbal

expressions of emotions, and the influence of social context and development on these expressions. Since each of the core chapters included its own general discussion, we shall be relatively brief here. We also formulate implications for current emotion research and we elaborate on directions for future research.

Nonverbal Expressions of Emotions

One contribution this dissertation makes to current emotion research is that it examines the presence or absence of prototypical nonverbal features in spontaneously expressed emotions. Earlier research has argued that prototypical expressions of a number of emotions are recognized similarly by people across cultures (e.g., Ekman & Friesen, 1975; 1978). However, there is a growing awareness amongst researchers that the spontaneous expressions people use in their natural interactions do not always match "standard", prototypical displays of emotion (e.g., Fernández-Dols & Ruiz-Belda, 1997; Fischer, Manstead, & Zaalberg, 2003; Reisenzein, Bördgen, Holtbernd, & Matz, 2006; Russell, Bachorowski, & Fernández-Dols, 2003). According to appraisal theory, in particular, emotional expressions are constructed by an individual's subjective appraisal (or judgment) of a situation, the outcome of which depends on the validation of personal needs, goals and values (e.g., Frijda, 1986; Mumenthaler & Sander, 2012; Scherer, 2009; Scherer, Schorr & Johnstone, 2001). Therefore, we hypothesized that the nonverbal features people use to express their emotions may vary as a function of their appraisals.

Throughout the studies in this dissertation, we tried to systematically vary factors that may influence participants' appraisals while eliciting nonverbal expressions of emotions. In this way, we were able to examine to what extent people rely on prototypical displays of emotions. In Chapter 2, we specifically focused on the nonverbal expression of the basic emotion surprise. When examining the prototypical surprise features by means of labeling studies (raising eyebrows, widening eyes and dropping of the jaw), we did not find any differences in the use of these specific features by participants across the different appraisal conditions. However, in our perception studies, in which we asked third party judges to rate participants' level of surprise, we did find that the perception of surprise expressions varied. This discrepancy in outcomes of the labeling studies and the perception studies suggests that spontaneous surprise expressions in natural settings may vary gradually, but the specific cues that are used do not appear to differ. Possibly, a variation in appraisals is only relevant for

the *intensity* of spontaneous surprise expression (see Figure 6.1 for representative examples of participants who use the same features, raising eye brows and widening eyes, for surprise caused by an unexpectedly correct answer and an unexpectedly incorrect answer).

Figure 6.1. Representative examples of participants who display surprise, caused by (left) an unexpectedly correct answer, or (right) an unexpectedly incorrect answer.

However, in contrast with the *basic* emotion surprise, our studies in Chapter 4 and 5 revealed that the non-basic *social* emotion uncertainty can indeed be cued by different expressive features,. For example, children used features like opening their mouths and gazing when uncertain, whereas adults used these features to a lesser extent, possibly because adults are more aware of their social environment than children (Krahmer & Swerts, 2005). In contrast, older adults tended to use features like frowning more often, which may be explained by their difficulties with retrieving answers (Gollan & Brown, 2006). We will elaborate on these developmental differences further ahead in this discussion section. It seems that the expression of a social emotion like uncertainty is more affected by individual contextual factors, such as someone's age and social awareness, than the expression of a basic emotion like surprise.

We can conclude that this dissertation contributes to the idea that people do not necessarily use prototypical features for expressing spontaneous emotions. These expressions are likely to vary as a function of several factors, influencing either the intensity of the expression (as we found for surprise) or the use of different features (as we found for uncertainty). Our outcomes support the general view of appraisal theories (e.g., Scherer, 2009), which state that

emotional expressions are constructed as cognitive appraisals nested in behavioral scripts. As a result, different people may express the same emotion differently, depending on these factors (Mumenthaler & Sander, 2012). In the next sections we will elaborate on the impact of social context and age for the nonverbal expression of emotion.

Social context

This dissertation aimed to find further evidence for how specific social contexts affect the way people non-verbally express their emotions. By varying the social context in which the emotion elicitation took place, we examined in which way people regulate their emotional nonverbal behavior. The way social contexts may affect emotional expressions has often been framed in terms of so-called display rules, which are principles that help individuals manage and modify their emotional expressions. In addition, these display rules are dependent on social circumstances, and may serve both pro-social and self-protective functions (Ekman & Friesen, 1975). According to theses display rules, people manage their emotional expressions, by exaggerating, minimizing, neutralizing, masking or simulating them (Matsumoto, Hee Yoo, Hirayama & Petrova, 2005; Saarni, Campos, Camras & Witherington, 2006). In this way, people are able to regulate interactions and relationships with others (DePaulo, 1992; Ekman & Oster, 1979; Wagner & Lee, 1999; Yamamoto & Suzuki, 2006). We expected our participants to adjust their emotional expressions according to display rules that fitted their social context, whether this was a game context (i.e., collaboration or competition) or the presence of a peer.

Throughout this dissertation, we firstly found that participants' expressive behavior was affected by the presence of peers. For example, in the study described in Chapter 3, in which we gave children satisfying or disappointing prizes, we found that when they were in the company of a peer, children used different nonverbal behavior to signal their emotions than when they were alone. More specifically, results showed that, irrespective of their age and whether the prize they received was satisfying or disappointing, children were perceived as happier when they were in the presence of a peer compared to when they were alone. In addition, children were perceived as happier after they had made eye contact with their peer, compared to when they had not yet established eye contact.

Moreover, we found that participants' nonverbal expressions of emotions varied depending on whether they were in a collaborative context or a competitive context. In the studies described in Chapter 2 and 4, participants were instructed to play a game in either collaboration or competition with someone else. We found that this influenced participants' nonverbal emotional expressions. For example, our study on expressing uncertainty in social contexts (as described in Chapter 4) showed that competing children used more nonverbal cues to express uncertainty compared to collaborating children. We argued that this might be because the application of self-protective display rules may be more important in competition than in collaboration. For the expression of surprise, we also found that competitive contexts, compared to collaborative contexts, caused participants to be more expressive (as described in Chapter 2). Apparently, competitive contexts result in people more openly expressing their emotions, more so than when they are in collaboration. In general, we can conclude that the way we nonverbally express emotions depends on our social context, whether this is a game context (i.e., collaboration or competition) or the presence of others.

Development

This dissertation presented a developmental approach to the way nonverbal expressions of emotions are affected by contextual factors. It has been argued that people's use of nonverbal cues develops as a function of their increasing knowledge of display rules and in order to meet personal goals and expectations of their surroundings (Garret-Peters & Fox, 2007; Gnepp & Hess, 1986; Saarni, 1984). Therefore, we examined the nonverbal expressions of emotions of different age groups that varied in their social skills. In our studies we compared both nonverbal expressions of 8-year-old and 11-year-old children, as well as those of younger and older adults.

Younger versus older children. Earlier research showed that as children grow up, they start making better use of nonverbal features for social purposes. More specifically, children's social awareness and knowledge of display rules has been argued to increase with age and as a result, children learn, as they grow older, what type of nonverbal behavior is considered to be appropriate or effective in specific social contexts (Ekman & Oster, 1979; Gnepp & Hess, 1986; Saarni, 1979). Saarni (1981) showed that children's knowledge of display rules substantially increases between the ages of 8 and 11. Therefore, we hypothesized that children of these age groups differed in our studies in their expressive

emotional behavior, as a function of the social context (i.e., the presence of others and game context; whether they were in a collaborative or a competitive context)

Throughout this dissertation, we found interaction effects of children's age and *the presence of others*. For example, Chapter 3 showed that when 8-year-old children received a disappointing prize after playing a game, they seemed to be happier with the prize when they were alone compared to when they were in the presence of a peer. This was not the case for 11-year-old children, whose emotional expressions were not affected by the presence of peers. Additionally, we found that in the course of an emotional response, having eye contact with a peer has a different effect on the nonverbal expressions of younger and older children; older children appeared happier after making eye contact, whereas younger children appeared less happy after they had looked at their peers. Both findings are in line with earlier research that found older children to show less disappointment than younger children, which has been attributed to the 11-year-olds improved knowledge of display rules (Cole, 1986; Garner & Power, 1986; Kieras, Tobin, Graziano & Rothbart, 2005).

Moreover, this dissertation repeatedly showed support for our expectation that *game context* (i.e., collaborative and competitive contexts) interacts with age on nonverbal emotional expressions as well. For example, in Chapter 4, we found that the social context did not affect 8-year-old children's expression of uncertainty, while there was a clear difference for 11-year-old children, who showed more certainty in competition than in collaboration. This indicates that when social awareness is more developed, children find expressing certainty more important in competition than in collaboration. In Chapter 2, we also found that social context interacted with age, for the degree of surprise participants expressed nonverbally. More specifically, 8-year-old-children were not affected by the social context they were in in their degree of surprise they showed, contrary to 11-year-old children, who were perceived to be more surprised in competitive contexts than collaborative contexts. These results indicate that as children grow older and develop their social skills, their social awareness increases and they adjust their nonverbal expressions of emotions as a function of their social context.

Children versus young adults. We found several effects of contextual factors on nonverbal emotional expressions by adults, which we did not find for our child participants. For example, Chapter 2 showed interactions between cause of surprise and social context (i.e., collaboration and competition) with adults, but not with child participants. The way adults expressed their surprise in

competition or collaboration depended on the specific event that caused the emotion (i.e., an unexpectedly correct or incorrect answer). In general, children were more expressive in competition than in collaboration when displaying surprise, regardless of whether the emotion was caused by an unexpectedly correct or incorrect answer. However, similar to our adult participants, 11-year-old children expressed more surprise in response to unexpectedly correct answers than 8-year-old children. Apparently, as people grow older, the display of surprise becomes more influenced by contextual factors.

Moreover, the research in this dissertation revealed cases in which children, compared to adults, use different features for the expression of emotions. In Chapter 4 we found that children, contrary to adults, do not systematically use fillers to express uncertainty, like "uhm", or hedges such as "I think the answers would probably be something like…". They did use funny or thinking faces to express their uncertainty, unlike adults in earlier studies on expressing uncertainty (Krahmer & Swerts, 2005). Intuitively, one might consider the use of hedges for showing uncertainty to be more strategic (because they are more explicit) than the use of funny or thinking faces. Taken together, these findings suggest that although children seem to be aware of the self-presentational factor of expressing uncertainty, their strategy to signal this may not be as fully developed as that of adults.

Young adults versus older adults. The final study of this dissertation, described in Chapter 5, looked into the way older adults express the socially constructed emotion of uncertainty. Previous research has shown that emotional expressiveness appears to decrease with age, which is why we expected older adults to decrease their uncertainty expressions (Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Gross et al., 1997; Levenson, Carstensen, Friesen & Ekman, 1991). However, when studying older adults' use of nonverbal cues for showing uncertainty, we found a similar pattern as in studies on uncertainty with young adults (Krahmer & Swerts, 2005). Like younger age groups, older adults used more nonverbal cues for signaling uncertainty than for signaling certainty. Moreover, when older adults were unable to retrieve an answer, they signaled this more when they were experiencing a high Feeling-of-Knowing than when they were experiencing a low Feeling-of-Knowing. We may conclude that older adults, similarly to younger age groups, tend to display cues to low Feeling-of-Knowing, despite the alleged decrease in emotional expressiveness of older adults (Carstensen et al., 2000; Gross et al., 1997; Levenson et al., 1991). However, Charles and Carstensen (2007) state that this decrease may be caused by the

better-developed emotion regulation system of older adults. This would explain why older adults in our study do express their uncertainty, considering the self-presentational, face-saving nature of expressing uncertainty that might lower recipients' expectations regarding the speaker's performance (Smith & Clark, 1993).

Implications and Future Research

This dissertation has several theoretical and methodological implications for future studies on (nonverbal) emotional expressions.

First, previous researchers generally tended to study emotions in a non-social setting, aiming to get a "clean view" on emotional expressions (e.g., Reisenzein et al., 2006). However, the research presented in this dissertation contributes to the idea that nonverbal emotional expressions are subjective to individual and contextual factors (in line with research by e.g., Scherer, 2009). Our studies repeatedly showed effects of factors such as the presence of others and whether a social context was collaborative or competitive on the way participants expressed emotions of surprise, happiness, disappointment and uncertainty. Based on this, we argue that social context should receive a more prominent role in future studies of emotional expressions. This focus on contextual factors is in line with our conjecture that it is important to look at the *social function* of nonverbal expressions. Our studies showed that people adjust their nonverbal behavior as a function of social context, presumably by applying relevant display rules (Saarni et al., 2006). Earlier research underestimated or has not taken into account these social functions of emotions when looking at developmental or cultural aspects of emotions (e.g., Ekman & Friesen, 1975; 1978). Therefore, we would like to urge researchers to study the social function of nonverbal emotional expressions.

Second, we would like to stress the importance of perception experiments for studying nonverbal expressions of emotions. As we stated earlier, perception experiments are known to be valuable instruments for assessing changes in socially embedded expressive behavior, because the perceptual meaning of expressions is rated by multiple judges, in contrast to labeling studies in which only two or three labelers use a fixed coding scheme. In addition, perception experiments may also give additional information on the way others assign meaning to nonverbal expressions of emotions (e.g., Kromm, Farber & Holodynski, 2014). Still, combining perception experiments with labeling studies is preferable. In this way, a detailed overview is obtained regarding the non-

verbal cues that are used for the expression of particular emotions and this can be helpful for explaining effects found in perception studies. However, when using labeling studies for examining nonverbal expressions of emotions, we consider it important to not only focus on action units that match the specific emotion (like raising eye brows, widening eyes and dropping jaw for the expression of surprise, as formulated by Ekman and Friesen, 1978), but to also consider context-related features, like we did in the study described in Chapter 3 (on surprise, in which we took into account valence related features, like frowns and smiles), and in the study described in Chapter 5 (on uncertainty with older adults, in which we took into account signals of frustration, like frowns and nose wrinkles).

Third, we would like to underline our studies' success rate of eliciting emotional expressions with participants, compared to earlier studies in which difficulties with elicitation were reported (e.g., Reisenzein et al., 2006). The general methodology used in this dissertation combined advantages of both laboratorial settings and more field-like approaches (Fernández-Dols, 2013; Hubbard, 2001). More specifically, we aimed for controlled settings that were as natural as possible, by using a game-based approach. In this way, we were successful in eliciting spontaneous nonverbal emotional expressions with participants of all age groups in a controlled manner.

Conclusion

Overall, this research contributes to the idea that nonverbal emotional expressions are by no means isolated, but are constructed by the assessment of a (social) context (i.e. social appraisals). As our social awareness increases, our nonverbal expressions are more affected by these social appraisals. Therefore, future research should consider contextual factors when examining nonverbal emotional expressions.

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Summary

This dissertation took a developmental approach to nonverbal expressions of emotion, and specifically examined to what extent social contextual factors have an impact on these expressions. To this end, we conducted a number of experimental studies, in which we aimed to elicit spontaneous emotional reactions in a dynamic but controlled way. Our participants were of different age groups, from primary school children to older adults, and were analyzed as a function of the social context they were in (e.g., competition versus collaboration, alone versus in the presence of a peer).

The first study, in Chapter 2, investigated to what extent the nonverbal expression of the basic emotion of surprise is affected by situational factors. More specifically, we examined surprise reactions of children and adults while varying the cause of the surprise (unexpectedly correct answers versus unexpectedly incorrect answers) and the social context in which the emotion occurred (collaboration versus competition). Results showed that cause and social context did not affect the appearance of specific features in participants' surprise display. However, we did find these factors to interact with regards to the intensity of perceived surprise displays of adults. For children, these relations were less complex. Overall, we concluded that the expression of surprise is indeed moderated by contextual factors, namely cause of the surprise, social context, and age.

Next, Chapter 3 described a study that focused on children's expressive behavior when they receive a disappointing gift or a satisfying gift and whether this is affected by the presence of a peer. More specifically, this study analyzed whether children's expressive behavior differed when a peer receives a gift that is judged to be better or worse than the one they just received. Moreover, we studied how children's nonverbal expressions changed in the course of their response. In doing so, we were specifically interested in the extent to which changes in children's assessment of the social contact (which we operationalized as the children's reaction before and after eye contact with their peer) had an impact on their emotional expressions. Results showed that co-presence positively affected children's happiness only when receiving the first prize. Moreover, for children who were in the presence of a peer, we found that eye contact affected expressions of happiness of 8-year-old children negatively and that of 11-year-old children positively. Overall, we concluded that as children grow older and their social awareness increases, the presence of a peer affects their expressions, regardless of their appreciation of their prize.

Whereas Chapters 2 and 3 mainly focused on the expression of what has traditionally been considered to be basic emotions, the studies described in

Chapters 4 and 5 were concerned with the nonverbal expression of a non-basic, socially constructed emotion, namely uncertainty. To elicit nonverbal expressions that varied in levels of (un)certainty, we used variations of the Feeling-of-Knowing paradigm as designed by Hart (1965). Chapter 4 described a game-like Feeling-of-Knowing experiment with child participants, in which we varied the social context of the game (collaboration versus competition). We found that the Feeling-of-Knowing of 8-year-old children did not seem to be affected by the social setting, contrary to the Feeling-of-Knowing of 11-year-old children. Additionally, we labeled children's expressions in clips taken from the experiment for various visual and auditory features. We found that children used some of these features to signal uncertainty and that older children exhibited clearer cues than younger children. In a subsequent perception test, adults rated children's certainty in clips used for labeling. It appeared that older children and children in competition expressed their confidence level more clearly than younger children and children in collaboration.

The study on which we reported in Chapter 5 provided insight into expressions of uncertainty by older adults. In this way, we were able to get an overview of how nonverbal expressions of emotions develop as people grow older. Twenty-four older adults (with an age ranging from 70 to 95) were video-recorded while participating in a Feeling-of-Knowing task. Their nonverbal behavior during the recall phase was manually and automatically annotated (using facial expression detection software) and evaluated. Additionally, judges rated older adults' recall in a perceptual study involving the Feeling-of-Another's-Knowing (FOAK) paradigm. There was an overall effect of FOK ratings on the use of FOK related nonverbal features by older adults. For recalled items, the participants used more nonverbal cues with lower FOKs than with higher FOKs. For unrecalled items, the opposite effect was found. The perceptual study indicated that third-party judges were able to estimate older adults' FOK. We concluded that older adults display standard nonverbal cues associated with Feeling-of-Knowing with a level of accuracy comparable to younger age groups.

Overall, this dissertation contributes to current research concerning the topic of nonverbal emotional expressions and social factors in several ways. First, we found support for the idea that people do not necessarily use prototypical features for expressing spontaneous emotions. These expressions appeared to vary as a function of several factors, influencing either the intensity of the expression (as we found for surprise) or the use of different features (as we found for uncertainty). Our outcomes supported the general view of appraisal theories (e.g., Scherer, 2009), which state that emotional expressions are

constructed as cognitive appraisals nested in behavioral scripts. As a result, different people may express the same emotion differently, depending on these factors (Mumenthaler & Sander, 2012). Second, we concluded that the way we nonverbally express emotions depends on our social context, whether this is a game context (i.e., collaboration or competition) or the presence of others. Third, we found support for the idea that the use of nonverbal emotional expressions changes over age. As children grow older and develop their social skills, their social awareness increases and this dissertation showed that children adjusted their nonverbal expressions of emotions as a function of their social context. Taken together, these findings suggested that although children seem to be aware of the self-presentational factor of expressing emotions, their strategy to signal this might not be as fully developed as that of adults. Moreover, we found that older adults expressed the emotion of uncertainty similarly to younger age groups, despite the alleged decrease in emotional expressiveness of older adults (Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Gross et al., 1997; Levenson, Carstensen, Friesen & Ekman, 1991). However, Charles and Carstensen (2009) state that this decrease may be caused by the better-developed emotion regulation system of older adults. This would explain why older adults in our study do express their uncertainty, considering the self-presentational, face-saving nature of expressing uncertainty that might lower recipients' expectations regarding the speaker's performance (Smith & Clark, 1993).

The studies described in this dissertation implied several theoretical and methodological implications for future studies on (nonverbal) emotional expressions. First, we urged researchers to focus on the social function of nonverbal emotional expressions. Second, we stressed the importance of perception experiments for studying nonverbal expressions of emotions. Third, we underlined our studies' success rate of eliciting emotional expressions with participants, compared to earlier studies in which difficulties with elicitation were reported (e.g., Reisenzein, Bördgen, Holtbernd, & Matz, 2006). We aimed for controlled settings that were as natural as possible, by using a game-based approach. In this way, we were successful in eliciting spontaneous nonverbal emotional expressions with participants of all age groups in a controlled manner.

Overall, this research contributes to the idea that nonverbal emotional expressions are by no means isolated, but are constructed by the assessment of a (social) context (i.e. social appraisals). As our social awareness increases, our nonverbal expressions are more affected by these social appraisals. Therefore, future research should consider contextual factors when examining nonverbal emotional expressions.

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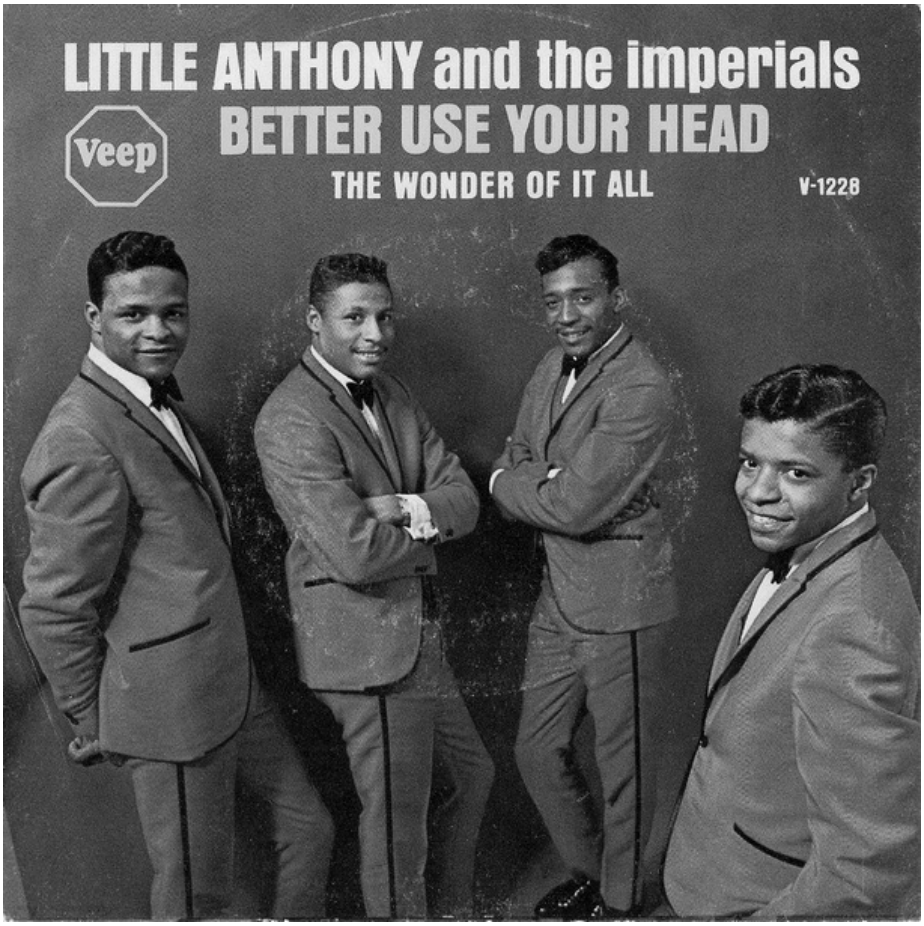
Acknowledgments

**Because I would like to thank both Dutch and non-Dutch people, I switch between Dutch and English in my acknowledgments. Please forgive me for any unanswered curiosity. Translations on request!*



Een wel gewaardeerde collega drukte mij op het hart om een CV in mijn proefschrift op te nemen. Niet zo'n suf lijstje met publicaties, maar iets leuks, iets leesbaars. "Je bedoelt het dankwoord?" vroeg ik. "Nee gatver, dat is zulk gezwijmel. Ik wil een stukje waarin je vertelt wat je hobby's zijn, en waarom in de zandbak al duidelijk was waarom je dit proefschrift zou schrijven".

Bij een hobby denk ik aan vroeger: je "zat ergens op" en daar ging je dan iedere week naartoe. Ik zat vroeger op basgitaarles. Een van de eerste deuntjes die ik leerde was "Better use your head" van Little Anthony and the Emperials. Toen ik al surfend op het web op zoek was naar een titel voor mijn proefschrift, en met enige omwegen bij dit nummer terecht kwam, was de keuze snel gemaakt. Naast dat de tekst van dit bescheiden hitje in verschillende interpretaties perfect

aansloot op de inhoud van mijn proefschrift, had ik namelijk meteen weer zin om mijn basgitaar uit het stof te trekken. “Better use your head" is bovendien een frase waarvan het misschien goed is om die regelmatig onder ogen te zien, ook al is dat maar op een plank in mijn boekenkast. Wie weet helpt het mijn “eerst doen dan denken” mentaliteit te beteugelen. Een instelling die niet perse heel handig is voor het schrijven van een proefschrift. Waarschijnlijk had ik dat eerder moeten bedenken. Ehm. Ja.

Over die zandbak, ik was daar helemaal niet goed in het aanpassen van mijn emoties naar mijn sociale context (ook wel het onderwerp van mijn proefschrift, mocht je meteen doorgebladerd hebben naar het dankwoord. Snap ik). Integendeel misschien zelfs, en dat maakte mij niet bepaald het populairste meisje van het schoolplein. Maar, het vertalen van persoonlijke kwesties naar wetenschappelijke vraagstukken kwam pas later, bij de verdediging van Marjolijn Antheunis, mijn toenmalige scriptiebegeleidster, in de Agnietenkapel te Amsterdam. “Dat is toch je grootste nachtmerrie..!?”, was mijn exacte bewoording na het hele gebeuren. Maar Marjolijn heeft me, zoals ze dat zo goed kan, overtuigd van een wetenschappelijke carrière. Nu figureert ze aanstaande 10 juni als een van mijn paranimfen.

Want daar ligt dan toch echt een proefschrift, waarvan de prachtige cover overigens is gemaakt door Inge Trienekens (een getalenteerde kunstfotografe die momenteel de wereld verovert. Goed bewaren dus, dit collector’s item!). Over niet al te lange tijd sta ik op een podium, paranimfen achter mij, ten overstaande van een commissie, begeleiders, collega’s, vrienden en familie. Zonder uitzondering, allemaal figuren die op uiteenlopende manieren hebben bijgedragen aan deze verzameling van studies, een klein levenswerk van krap vijf jaar. Aangezien ik het gemakkelijker vind een dankwoord voor anderen te schrijven dan een CV over mezelf (sorry Carel), zou ik graag de ruimte willen nemen om dezen en genen uitvoerig voor hun aandeel te bedanken. Komt ie.

First of all, I would like to thank my committee members for their valuable suggestions after reading the dissertation, and for finding the time and taking the effort to travel all the way to the auditorium of Tilburg University to attend my defense (whether that is just from the other side of the campus or from the other side of the world). I hope I can fulfil your expectations.

Sommige leden van mijn promotiecommissie komen van ver, zelf woon ik ook niet bepaald in Tilburg West. Gemiddeld heb ik gedurende de afgelopen 4,5 jaar vier dagen per week 220 km afgelegd. Klein rekensommetje, dat is 4,5x52x4x220 = 205920 km. Dit betekent dat de NS mij net zo goed vijf keer de aarde om had

kunnen treinen. Zowel Tillie (Tilburg voor outsiders) als Amsterdam zijn de afgelopen jaren als "thuis" gaan voelen. Mijn zuidelijke thuishaven is vooral gedefinieerd door mijn lieve en inspirerende collega's.

Het duo dat ik als eerste wil bedanken voor hun enorme toewijding aan mijn onderzoek bestaat uit mijn begeleiders Marc Swerts en Emiel Krahmer, die bewijzen dat 1 plus 1 echt weleens 3 is. Werkdipjes, schrijfblokkades, onderzoekscrisissen, relatieperikelen, allemaal kwamen voorbij en maakten de begeleiding van mijn promotieproject vast niet de gemakkelijkste, maar hopelijk wel wat interessanter. Hun relativeringsvermogen heeft er meerdere malen voor gezorgd dat wanneer ik zeker wist dat het nóóit-meer-goed kwam, ik na twee minuten met Marc en Emiel op mijn hoofd krabbend een kamer uitliep, en eigenlijk niet zo goed wist waar ik me nu zo druk om had gemaakt. Ik kan me heel goed voorstellen dat zij me (vooral) de laatste maanden het liefst achter het behang hebben willen plakken. Bedankt dat jullie dat niet hebben gedaan en er altijd voor me zijn geweest. Ook wanneer mijn begeleiding wat extra aandacht nodig had, zoals tijdens de opeens ongeduldige afronding van het proefschrift rond kerst en afhandelingen van het een en ander terwijl ik in Australië was. Marc en Emiel, bedankt voor alle inspiratie en inzichten die mijn proefschrift hebben gemaakt tot wat het nu is. Ik hoop dat we in de toekomst nog samen kunnen werken. Lieve Marc, mijn (meer dan) Hollandse directheid en jouw (meer dan) Vlaamse voorzichtigheid gebood wat acclimatisatie, maar resulteerde al snel naast de doeltreffende schoppen onder mijn kont, ook in fijne en persoonlijke gesprekken. Bedankt daarvoor! Lieve Emiel, jouw onwaarschijnlijk goede planning zorgt er altijd voor dat je zeeën van tijd lijkt te hebben, ondanks dat je bergen aan werk verzet. Hoe je dit doet was mij een raadsel, totdat ik erachter kwam dat de watervlekken op mijn door jou gereviseerde stukken veroorzaakt werden doordat je in bad mijn schrijfsels nakeek. Bedankt voor deze toewijding en voor je interesse, in proefschrift-, carrière- en privéaangelegenheden.

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Ook van niet-collega's heb ik bij de totstandkoming van dit proefschrift de nodige praktische steun gehad. Zonder de hulp van studenten Manuela, Vera,

Tineke en Elise bij het labelen en verzamelen van data was ik waarschijnlijk nog steeds “kleine glimlachen” van “grote glimlachen” aan het onderscheiden, of was ik al gebakjes etend 80-plussers aan het filmen. Naast het verzorgingstehuis, mijn bureau in Tilburg en mijn thuiswerkkantoren in Amsterdam, -de Ysbreeker, Coffeecompany of de OBA-, heb ik een aantal weken doorgebracht op scholen in Zoetermeer. Ik ben Irma Ronkens (OBS de Waterlelie en OBS de Tjalk) en Diny van den Berg (OBS Florence Nightingale) heel dankbaar voor de gastvrijheid en welwillendheid om mee te werken aan mijn studies.

Naast dat ik mijn proefpersonen wil bedanken voor hun tijd en energie, denk ik dat een welgemeende excuses aan hun adres ook op zijn plaats is. Mijn experimenten waren namelijk niet altijd even leuk om aan mee te doen, al doet het spelen van spelletjes, het uitgangspunt van mijn studies, anders vermoeden. Vooral in testfases moest ik het uitlokken van onzekerheid, verrassing en teleurstelling nog een beetje fine-tunen. Zo heb ik een oudere dame een quiz spel laten spelen waarbij ik haar kennis iets verkeerd had ingeschat. Ze wist geen enkel antwoord en werd inderdaad steeds onzekerder; “wat zijn dit voor belachelijke vragen? Ik ben toch niet dom?”. Haar door mij uitgelokte non-verbale gedrag sprak boekdelen. Ik heb het goedgemaakt met een mokkagebakje en een uur onverdeelde aandacht. Daarnaast heb ik meerdere keren ouders achtergelaten met huilende kinderen omdat “die mevrouw mij het grote cadeau niet gaf”. Ik bleek iets te resoluut in mijn aanpak om teleurstelling uit te lokken. Ik heb mijn laptop kunnen redden van een gooi uit het raam, maar betwijfel of het ooit nog goed komt met mijn karma.

Ik heb geleerd dat het hebben van academische vrienden cruciaal is tijdens het schrijven van een proefschrift. Er zijn een aantal collega’s die iets verder van mijn project staan, maar daarom niet minder belangrijk.

Marjolijn, bedankt voor alles. Sinds onze ontmoeting in de kantine van het Bushuis ben jij voor mij een voorbeeldfiguur en adviesbaken: van het schrijven van mijn masterscriptie en het vinden van een promotieplek, tot make up en panty aankopen. Ik kan altijd bij je terecht. Het meest illustratieve voorbeeld hiervan is voor mij de skypesessie toen ik aan de andere kant van de wereld was, waarin je, vanuit je bed, in je pyjama, bril en knot op je hoofd, luisterde naar mijn verhalen en advies gaf, lak hebbend aan de aantrekkelijke manfiguren die af en toe mijn scherm bekeken. Eerlijk is eerlijk, zonder jou was dit proefschrift er niet geweest. Hoe onzekerder ik ben over mijn kunnen, hoe harder jij juist roept dat ik het kan.

Lisanne en Marieke, jullie zijn mijn partners in crime in Tillie, degenen die

onvoorwaardelijk nooit op de trap stonden en andersom mij daar ook nooit op zetten. Sterke dames die zich op geen enkele manier uit het veld laten slaan. Ik heb geprobeerd daar een voorbeeld aan te nemen en als dat maar voor de helft gelukt is ben ik tevreden. Daarnaast zijn jullie altijd behulpzaam op alle vlakken. Ik denk dat mannen -van Castricum tot Canada- dat kunnen beamen. Lies, jij hebt me laten inzien dat een thuis niet gedefinieerd wordt door een locatie, maar door de mensen die je om je heen hebt. Ik ben trots dat je je rust hebt gevonden, en blij dat je nieuwe thuis op loopafstand is van het mijne. Ik ga ook nog even zwerven en dan gaan we daarna voor een thuiswerkplek (voor onszelf of voor anderen, wie weet). Mariek, Hoetjesdag heeft voor menigeen op de afdeling een bepaalde betekenis, die echter anders is dan die van mij. Op *mijn* Hoetjesdag mailde ik namelijk op de vroege ochtend een todo-lijst naar Marieke *Hoetjes*, rond lunch kreeg ik een appje van je of ik al iets had afgestreept en rond een uur of zes gaf ik aan je door dat mijn werkdag erop zat. Hoetjesdagen waren voor mij de meest productieve thuiswerkdagen van de afgelopen vijf jaar. Just sayin'.

Bart, van een verre collega naar mijn Aussie buddy for life! Sydney was een alles veranderende ervaring, en ik was blij dat ik jou bij me had om dat mee te delen. Jouw oneindige optimisme werkte altijd inspirerend. Bedankt voor alle gesprekken, hilarische feitjes, en film-, muziek-, en receptsuggesties, in en na Australië. Aangezien we nu een gezamenlijke Mayo hebben ben ik ervan overtuigd dat we dit nog lang kunnen voortzetten. Good on ya mate!

"Ehm, Martijn, ja Goudbeek ja, heb je even tijd of ben je heel druk..? ik heb een klein vraagje over…. (vul in: statistiek – literatuur – experimentdesigns - onderzoeksgroepen)". Altijd krijg ik uitgebreid antwoord en hulp (al laat mijn persoonlijke motivator wel even merken wat hij van de vraag vindt). Martijn, bedankt voor al je hulp, ideeën en suggesties bij het opzetten, uitvoeren en analyseren van mijn onderzoek. En natuurlijk voor je vooruit-nog-ééntje-dan-instelling, zoals bij de emotieconferentie in Tilburg, de biertuin in Japan, of toch weer een treintje later na een kerstborrel.

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And last, I want to thank some people I met in Sydney. My time in Australia was important for me –personally and professionally- and I am sure my thesis would not be the same without (although it may have been finished a couple of months earlier). Jeesun and Chris, thank you for the opportunity to spend time at MARCS, for our valuable discussions about research and taking us along to EPC in Brisbane. Jeesun, thanks for throwing chocolate at me whenever needed. Cheeky Greg, thank you for our valuable talks about work and non-work, and for your unlimited hospitality. Jette and Smithy, it was great to have you around, it felt like family, both in Sydney and Narrendera. Dear Laura, you being in Holland brought me a bit of Aussie back, and made me realize I made friends for life there. And of course thanks to Vincent, Michael (meanwhile in Australia..), Tim and everyone else, I hope to come back some day!

Er zijn ook een aantal belangrijke mensen in mijn leven die helemaal niets met mijn proefschrift te maken hebben gehad, en waarvan sommigen nog steeds denken dat ik ga afstuderen in plaats van promoveren. Dat geeft toch niet, in ruil krijg ik er veel liefde en steun voor terug.

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Publication list

Journal papers

Visser, M., Kramer, E. J., & Swerts, M. (2014). The nonverbal expression of surprise: effects of cause, social context and age. *Journal of Nonverbal Behavior, 38*, 523-547.

Visser, M., Kramer, E. J., & Swerts, M. (2014). Children's expression of uncertainty in collaborative and competitive contexts. *Language and Speech, 57,* 86-107.

Visser, M., Antheunis, M. L., & Schouten, A. P. (2013). Online communication and social well-being: How playing World of Warcraft affects the players' social competence and loneliness. *Journal of Applied Social Psychology. 43,* 1508-1517.

Working papers

Visser, M., Postma-Nilsenova, M., Krahmer, E. J., & Swerts, M. G. J (submitted). Nonverbal predictors of metamnemonic judgments in older adults: Feeling of knowing and its perception.

Visser, M., Krahmer, E. J., & Swerts, M. G. J. (submitted). Never look a gift horse in the mouth: Children's spontaneous emotional expressions while receiving (un)wanted prizes in the presence of peers.

Papers in conference proceedings (peer reviewed)

Visser, M., Postma, M., Krahmer, E.J., & Swerts, M.G.J. (2014). Nonverbal cues of meta-memory awareness in older adults. In *Proceedings of the 36th annual meeting of the Cognitive Science Society (CogSci).* Quebec, Canada.

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Visser, M., & Antheunis, M. L. (2010). Online communication and social well-being: How playing World of Warcraft affects the players' social competence and loneliness. In *Proceedings of the annual meeting of the International Communication Association (ICA).* Singapore, Singapore.

Abstracts of conference presentations (peer reviewed)

Visser, M., Krahmer, E. J., & Swerts, M. G. J. (2014). Contextual effect on surprise expressions: a developmental study. Poster presented at the 41th annual meeting of the Australasian Experimental Psychology Society. Brisbane, Australia, April 2014.

Visser, M., Krahmer, E. J., & Swerts, M. G. J. (2011). Children's expression of surprise: investigating the development of social behavior. Talk presented at the International Conference on the (Non) Expression of Emotion in Health and Disease. Tilburg, The Netherlands, October 2011.

Visser, M., & Antheunis, M. L. (2010). Warprincess88 says: Hi! Een onderzoek naar de invloed van het spelen van World of Warcraft op de sociale competentie van jongeren. Talk presented at the Etmaal van de Communicatiewetenschap. Gent, Belgium, February 2010.

TiCC PhD series

(1) Pashiera Barkhuysen. *Audiovisual Prosody in Interaction.* Promotores: M.G.J. Swerts, E.J. Krahmer. Tilburg, 3 October 2008.

(2) Ben Torben-Nielsen. *Dendritic Morphology: Function Shapes Structure.* Promotores: H.J. van den Herik, E.O. Postma. Co-promotor: K.P. Tuyls. Tilburg, 3 December 2008.

(3) Hans Stol. *A Framework for Evidence-based Policy Making Using IT.* Promotor: H.J. van den Herik. Tilburg, 21 January 2009.

(4) Jeroen Geertzen. *Dialogue Act Recognition and Prediction.* Promotor: H. Bunt. Co-promotor: J.M.B. Terken. Tilburg, 11 February 2009.

(5) Sander Canisius. *Structured Prediction for Natural Language Processing.* Promotores: A.P.J. van den Bosch, W. Daelemans. Tilburg, 13 February 2009.

(6) Fritz Reul. *New Architectures in Computer Chess.* Promotor: H.J. van den Herik. Co-promotor: J.W.H.M. Uiterwijk. Tilburg, 17 June 2009.

(7) Laurens van der Maaten. *Feature Extraction from Visual Data.* Promotores: E.O. Postma, H.J. van den Herik. Co-promotor: A.G. Lange. Tilburg, 23 June 2009 (cum laude).

(8) Stephan Raaijmakers. *Multinomial Language Learning.* Promotores: W. Daelemans, A.P.J. van den Bosch. Tilburg, 1 December 2009.

(9) Igor Berezhnoy. *Digital Analysis of Paintings.* Promotores: E.O. Postma, H.J. van den Herik. Tilburg, 7 December 2009.

(10) Toine Bogers. *Recommender Systems for Social Bookmarking.* Promotor: A.P.J. van den Bosch. Tilburg, 8 December 2009.

(11) Sander Bakkes. *Rapid Adaptation of Video Game AI.* Promotor: H.J. van den Herik. Co-promotor: P. Spronck. Tilburg, 3 March 2010.

(12) Maria Mos. *Complex Lexical Items.* Promotor: A.P.J. van den Bosch. Co-promotores: A. Vermeer, A. Backus. Tilburg, 12 May 2010 (in collaboration with the Department of Language and Culture Studies).

(13) Marieke van Erp. *Accessing Natural History. Discoveries in data cleaning, structuring, and retrieval*. Promotor: A.P.J. van den Bosch. Co-promotor: P.K. Lendvai. Tilburg, 30 June 2010.

(14) Edwin Commandeur. *Implicit Causality and Implicit Consequentiality in Language Comprehension*. Promotores: L.G.M. Noordman, W. Vonk. Co-promotor: R. Cozijn. Tilburg, 30 June 2010.

(15) Bart Bogaert. *Cloud Content Contention*. Promotores: H.J. van den Herik, E.O. Postma. Tilburg, 30 March 2011.

(16) Xiaoyu Mao. *Airport under Control.* Promotores: H.J. van den Herik, E.O. Postma. Co-promotores: N. Roos, A. Salden. Tilburg, 25 May 2011.

(17) Olga Petukhova. *Multidimensional Dialogue Modelling*. Promotor: H. Bunt. Tilburg, 1 September 2011.

(18) Lisette Mol. *Language in the Hands.* Promotores: E.J. Krahmer, F. Maes, M.G.J. Swerts. Tilburg, 7 November 2011 (cum laude).

(19) Herman Stehouwer. *Statistical Language Models for Alternative Sequence Selection*. Promotores: A.P.J. van den Bosch, H.J. van den Herik. Co-promotor: M.M. van Zaanen. Tilburg, 7 December 2011.

(20) Terry Kakeeto-Aelen. *Relationship Marketing for SMEs in Uganda*. Promotores: J. Chr. van Dalen, H.J. van den Herik. Co-promotor: B.A. Van de Walle. Tilburg, 1 February 2012.

(21) Suleman Shahid. *Fun & Face: Exploring non-verbal expressions of emotion during playful interactions*. Promotores: E.J. Krahmer, M.G.J. Swerts. Tilburg, 25 May 2012.

(22) Thijs Vis. *Intelligence, Politie en Veiligheidsdienst: Verenigbare Grootheden?* Promotores: T.A. de Roos, H.J. van den Herik, A.C.M. Spapens. Tilburg, 6 June 2012 (in collaboration with the Tilburg School of Law).

(23) Nancy Pascall. *Engendering Technology Empowering Women.* Promotores: H.J. van den Herik, M. Diocaretz. Tilburg, 19 November, 2012.

(24) Agus Gunawan. *Information Access for SMEs in Indonesia*. Promotor: H.J. van den Herik. Co-promotores: M. Wahdan, B.A. Van de Walle. Tilburg, 19 December 2012.

(25) Giel van Lankveld. *Quantifying Individual Player Differences.* Promotores: H.J. van den Herik, A.R. Arntz. Co-promotor: P. Spronck. Tilburg, 27 February 2013.

(26) Sander Wubben. *Text-to-text Generation Using Monolingual Machine Translation.* Promotores: E.J. Krahmer, A.P.J. van den Bosch, H. Bunt. Tilburg, 5 June 2013.

(27) Jeroen Janssens. *Outlier Selection and One-Class Classification*. Promotores: E.O. Postma, H.J. van den Herik. Tilburg, 11 June 2013.

(28) Martijn Balsters. *Expression and Perception of Emotions: The Case of Depression, Sadness and Fear*. Promotores: E.J. Krahmer, M.G.J. Swerts, A.J.J.M. Vingerhoets. Tilburg, 25 June 2013.

(29) Lisanne van Weelden. *Metaphor in Good Shape.* Promotor: A.A. Maes. Co-promotor: J. Schilperoord. Tilburg, 28 June 2013.

(30) Ruud Koolen. *Need I say More? On Overspecification in Definite Reference.*Promotores: E.J. Krahmer, M.G.J. Swerts. Tilburg, 20 September 2013.

(31) J. Douglas Mastin. *Exploring Infant Engagement. Language Socialization and Vocabulary. Development: A study of Rural and Urban Communities in Mozambique.* Promotor: A.A. Maes. Co-promotor: P.A. Vogt. Tilburg, 11 October 2013.

(32) Philip C. Jackson. Jr. *Toward Human-Level Artificial Intelligence – Representation and Computation of Meaning in Natural Language.* Promotores: H.C. Bunt, W.P.M. Daelemans. Tilburg, 22 April, 2014.

(33) Jorrig Vogels. *Referential Choices in Language Production; The Role of Accesibility.* Promotores: A.A. Maes, E.J. Krahmer. Tilburg, 23 April 2014 (cum laude).

(34) Peter de Kock. *Anticipating Criminal Behavior.* Promotores: H.J. van den Herik, J.C. Scholtes. Co-promotor: P. Spronck. Tilburg, 10 September, 2014.

(35) Constantijn Kaland. *Prosodic Marking of Semantic Contrasts: Do Speakers Adapt to Addressees?* Promotores: M.G.J. Swerts, E.J. Krahmer, Tilburg, 1 October, 2014.

(36) Jasmina Marić. *Web Communities, Immigration and Social Capital.* Promotor: H.J. van den Herik. Co-promotores: R. Cozijn, M. Spotti. Tilburg, 18 November 2014.

(37) Pauline Meesters. *Intelligent Blauw.* Promotores: H.J. van den Herik, T.A. de Roos. Tilburg, 1 December 2014.

(38) Mandy Visser. *Better Use Your Head. How People Learn to Signal Emotions in Social Contexts.* Promotores: M.G.J. Swerts, E.J. Krahmer. Tilburg, 10 June, 2015.

"Would you tell me, please, which way I ought to go from here?"

"That depends a good deal on where you want to get to."

"I don't much care where –"

"Then it doesn't matter which way you go."

"...So long as I get somewhere."

"Oh, you're sure to do that, if only you walk long enough."

- Lewis Carroll, 1866